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Universal Milling Machine.

The accompanying illustration is of a milling machine, which is representative of a new line of similar machines which are just being brought out by the Garvin Machine Co., New York City.

The machine shown is designated by the makers the "No. 3," and is intended for such work as that done by steam engine and locomotive builders, where heavy cuts of considerable length are to be taken.

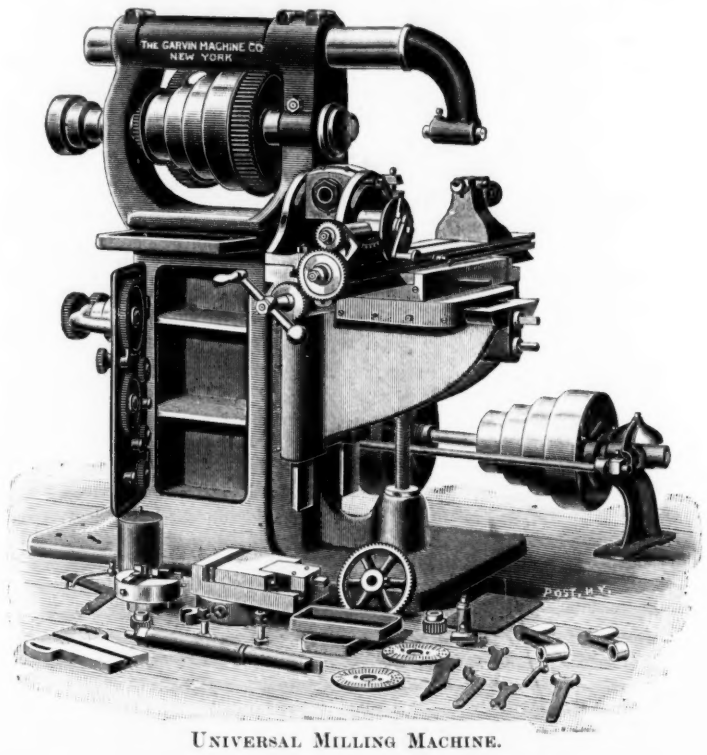
It will be noticed that the machine is back-geared, giving eight rates of speed, while by the introduction of spur gears between the various feed cones, a much greater range of feeds is obtainable than is usually the case, there being 24 rates of feed for each spindle speed. This makes it possible to use the automatic feed for all sizes of cutters, including the smallest stem cutters.

The spindle bearings are of a newly designed form, adapted to take up wear, and the outer bearing for the arbor is hardened and ground cylindrical in form, so that there is sufficient bearing surface and opportunity for expansion of the arbor by heating during the cut, without straining the machine or bringing undue pressure upon any part of it. The overhanging arm is held within a sleeve which joins the two standards, has a bearing in this sleeve at each end, and is clamped in position by three bolts.

The machine is universal, and is capable of doing a large range of indexing and spiral cutting. The feed is tripped automatically at any point, with the table moving in either direction. Shoulders of all actuating screws are provided with means for taking up the wear.

Graduations show the movement of the table in thousandths of an inch, and on the crank wrenches, where it is in plain sight of the operator when adjusting the machine, is stamped a table of decimal equivalents giving the number of graduations (thousandths) necessary to be moved to obtain the ordinary parts of an inch.

The overhanging arm is 5 inches diameter; front spindle bearing, 3x5½ inches. Work 13 inches diameter and 28 inches long can be placed between the centers, the table being 48 inches long and 7 inches wide. Table can be raised up to the spindle center or dropped 24½ inches below it; its in and out movement being 10¾ inches. The machine weighs 4,000 pounds. A still larger machine is built of the same general design, weighing 4,300 pounds.

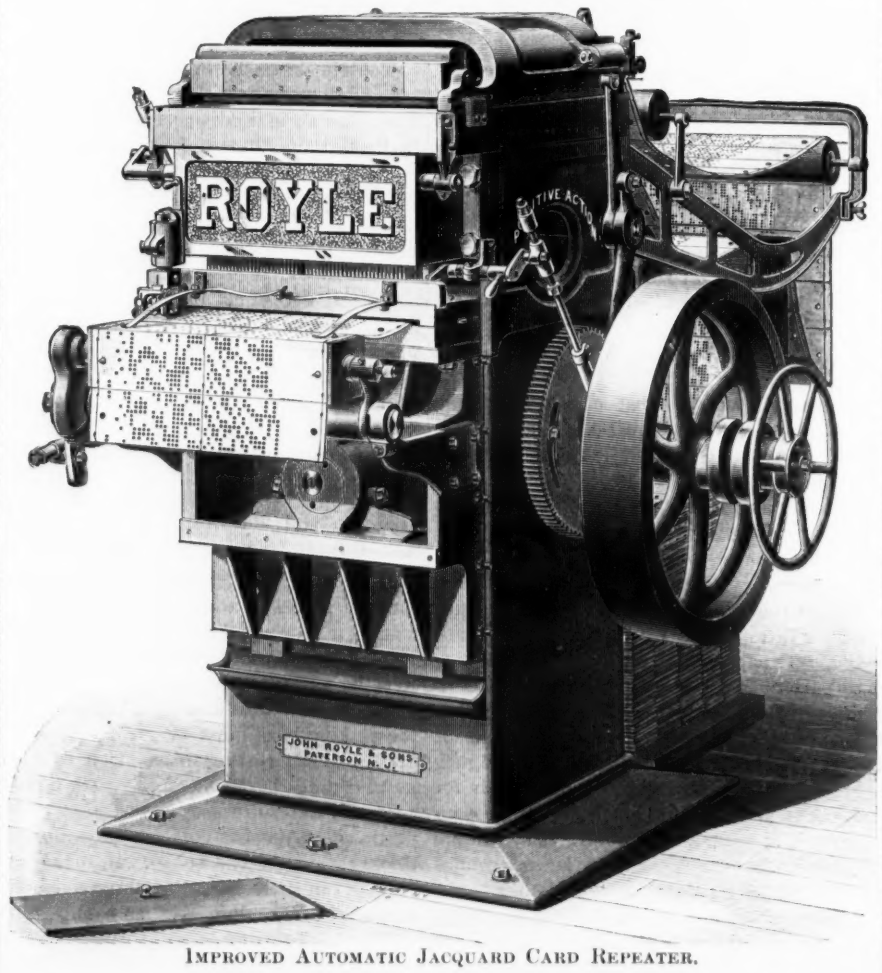


Universal Milling Machine.

It is said that the British parliamentary report, which has been tabulated in the House of Commons, shows the profits of sixteen collieries in that country for 1890 to be about $16,650,000.

The Philadelphia *Press* is authority for the statement that a strong effort will be made to place naphtha launches under rigid inspection laws.

One of the rapid transit commissioners of this city is quoted as saying that the commission had decided that the Greathead system of tunneling would not be adopted in building the new tunnels in New York City, but that instead of this a tunnel would be constructed as near the surface as possible, so as to avoid the use of elevators, and the work would be done by opening the street from the surface. If this means that the Greathead system is to be barred out entirely, we think it is a decided mistake. Experience seems to have abundantly proven that tunnels can be constructed on this system more cheaply than by any other, with far less disturbance of traffic, and that the tunnel, when finished, is a better one than any other, and in view of this it seems strange that plans should be adopted that make it impossible to use it. The use of elevators at stations would be no objection to the roads, so far as we can see. Transit in a vertical direction can now be as satisfactorily conducted as in a horizontal direction.



Improved Automatic Jacquard Card Repeater.

Improved Automatic Jacquard Card Repeater.

The lower illustration on this page and those on page 2 represent a positive action automatic repeater for Jacquard cards, and its attachments. The machine is designed for the use of all textile manufacturers, and is well adapted for rapidly reproducing Jacquard cards. The cards to be reproduced are arranged upon the extending card race arms in the same manner as upon a loom. The uncut or blank cards—having been previously laced together—are piled in the rear of the column, and from there are passed forward through the machine, and delivered finished at the front; every upward motion of the die cutting clearly into each card the requisite number of perforations.

All the motions of the machine are automatic. Its strength and power for doing the heaviest cutting required, large wearing surfaces and long bearings are the prominent constructive features.

The action of the punches is positive; every punch is mechanically returned to its normal position after the perforation of each card. The keys are worked by unfailing connections with a Jacquard. In this action no uncertain springs, or cords, are used, the sensitive touch of the selecting needle being transmitted to the punches with a certainty that insures a perfect reproduction of the pattern card. The feed motion of this machine regulates the feed of the cards to conform to the tension used in lacing them together, and this can be done while the machine is at work. In the motion for working the guide "pegs" and returning the punches, precision is a noticeable feature. The cutting die does its work in a powerful manner, the action being that of a short-stroke crank, applied through a yoke slide at the center of the die saddle. The effect is a very smooth working movement, which admits of a convenient vertical adjustment of the die, without interfering in any way with its smoothness of action. A new motion is used for turning the pattern cylinder, which adds much to the valuable features of the machine. The action of the punches is such as to produce a shearing effect, whereby one line of punches does its work very slightly in advance of the following line. This feature gives an easy action to the cutting process, and allows the use of thick cards when necessary. As there is of necessity in a machine of this kind a great multiplicity of parts, special care has been taken to make them easily accessible, should their removal for any cause become necessary. For instance, the whole Jacquard action—which is self-contained upon the cap plate—can be bodily taken out of the machine for examination or repairs, and the cutting plates, together with all the punches, may be easily removed for like reasons.

Adjustments to change the machine to produce 400^{s} or 600^{s} cards; 5 *fr.* or 6 *fr.* (Brussels), and the like, as may be required, are quickly made, a very few movements being necessary to adapt the machine to cut either size of card. The chips or cuttings pass from the die through a chute to the interior of the column, whence they may be removed by the door at the side. Guards or strippers are so arranged on the pattern and feed cylinder as to prevent the cards from lapping upon them, thus avoiding

annoying and possible damaging consequences. The connecting bow at the outer ends of the card race may be removed for facilitating the handling of large packs of pattern cards. Power is transmitted to this machine through an improved clutch that provides for the instantaneous stoppage of all working parts. Unwired cards may be used as pattern cards, when desired; this arrangement has been effected by recent improvement.

Compactness is another feature of the machine. It is built upon a heavy iron column 18x18½ inches, which stands upon a base 30½ x31½ inches. The height is 52 inches. Total weight of the machine, complete, is about 2,500 pounds.

LACE HOLE PRESS.

To a repeater the lace hole press is an indispensable adjunct. It is a separate little machine especially designed for cutting the "peg" and lace holes into the blank cards preparatory to their being laced together. This press is operated very readily by hand, but when so ordered may be adapted to run by power. The application of power, however, has been thoroughly tried, and is thought to be of doubtful economy. The construction of the machine provides for piling the blank cards directly in front, and within easy reach of the operator, permitting by this means the greatest facility and certainty in feeding with a single movement of the hand. By an ingenious device for locking and unlocking the punches, the press may be easily adjusted for cutting any size of card, the unlocking of one set of punches always securely fastening the opposite set. A shear arrangement of the punches is used similar to that used in the repeater; it is also provided with an easy adjustment of the die in the event of wear. In the make-up of the repeater this little machine constitutes an item of no little importance.

Size, 17x21x21¼ inches; weight, 175 pounds.

AUTOMATIC NUMBERING.

The illustration here given is of an improved numbering machine. It may be attached when so ordered to the repeater for numbering each card upon its delivery from the die. With this machine the numbering can be done consecutively, repeated by couplets, or its action can be entirely suspended at will. It is very simple in its construction, and equally so in its operation and management. For setting and readjusting the figure disk, an unavoidable necessity, the machine may be quickly turned aside, as shown by faint outline in engraving, and readily returned to place without in the least impairing its action. The machine is reliable, and will number up to 10,000. These machines are manufactured by John Royle & Sons, Paterson, N. J.

An Indicator of Acidity in Boiler Waters.

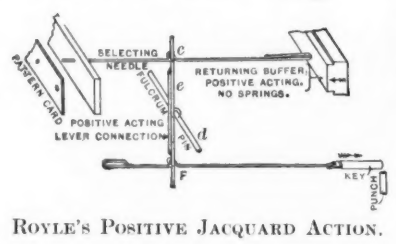
As is well known, water containing magnesium chloride is injurious to boilers, as the salt dissociates with the production of hydrochloric acid which attacks the plates. In large installations, where systematic purification of the feed water can be adopted, this evil is prevented, but in most cases the treatment in vogue consists in adding caustic soda to keep the contents of the boiler alkaline. An excess of the soda is wasteful and otherwise objectionable, and it becomes desirable to be able readily to ascertain when the water in the boiler ceases to contain alkali and needs a further supply. The handiest way to do this would be to have a certain quantity of some indicator always present in the boiler, but, unfortunately, all the usual indicators, such as litmus and turmeric, become decolorized under the influence of water at high temperature and pressure; the same objection applies to Congo red. Dr. Goldberg has, however, found that the sodium salt of paranitrophenol is entirely unaffected either by these conditions or by the salts usually present in feed waters. It is therefore possible, by introducing a sufficient quantity into the boiler, to judge of the alkalinity or acidity of its contents at any given moment by merely blowing the water out of the gauge glass and allowing it to refill. To give a distinct yellow color (the evidence of alkalinity) to the water, so that it may be seen in the small quantity of water in the gauge glass, about 30 to 50 grammes per cubic meter are requisite. The high price of the substance is the bar to its general use at present, the cost of the pure material being about 5s. a pound. As its successful application is not dependent upon its purity, a crude variety could doubtless be produced much more cheaply if a demand arose for it.—*Industries.*

Steel Castings.

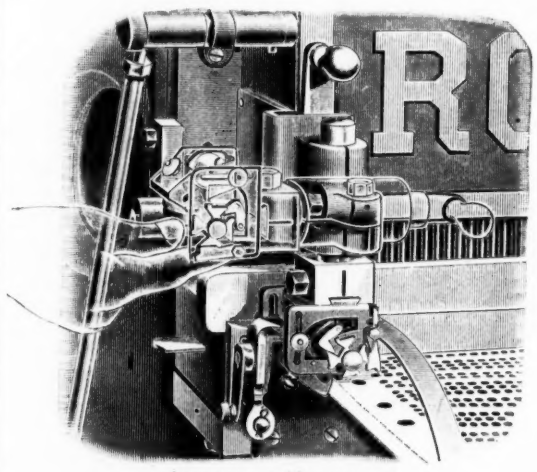
By H. L. Gantt, Philadelphia, Pa.

(A Paper Presented at the Providence Meeting of Mechanical Engineers.)

During the past few years steel castings have come extensively into use in the construction of machinery. The great power and size of many machines now being built demand a metal stronger than cast-iron, and steel seems to be the most suitable substitute. Steel castings, however, have not given universal satisfaction by any means.



Royle's Positive Jacquard Action.



Automatic Numbering.

Jacquard.

One man complains that they are not true to pattern; he has been using iron castings and expects those of steel to be as accurate as the iron ones. A little consideration will show that such expectation is unreasonable. Steel castings not only shrink much more than iron ones, but with less regularity. If iron castings are made from approximately the same grade of metal, they will be very nearly uniform in size. With steel castings the amount of shrinkage varies with the composition and the heat of the metal; the hotter the metal the greater the shrinkage; and, as we get smoother castings from hot metal, it is better to make allowance for large shrinkage and pour the metal as hot as possible. Then all castings should be thoroughly annealed, and in doing this a heavy scale is formed, leaving the casting pitted; this is very marked if the metal has been a little cool in pouring. We must not therefore expect to find steel castings as true to pattern as iron ones. The safest thing to do is to allow three-sixteenths or one-quarter inch per foot in length for shrinkage, except in very heavy castings, where one-eighth inch is sufficient, and one-quarter inch for finish on all machined surfaces except such as are cast "up." Cope surfaces which are to be machined should, in large or hard castings, have an allowance of from three-eighths to one-half inch for finish, as a large mass of metal slowly rising in a mold is apt to become crusty on the surface, and such a crust is sure to be full of imperfections. On small, soft castings, one-eighth inch on drag side and one-quarter inch on cope side will be sufficient. No core should have less than one-quarter inch finish on a side, and very large ones should have as much as one-half inch on a side. This seems a great deal, but will be found economical in the long run.

Another man will say that so many castings have "blow holes" in them. This is undoubtedly true; but unless the holes are so large as to make the appearance of the casting very bad, or occur on a wearing surface, they should not give any anxiety, as such metal is always tougher than solid metal of the same hardness. Blow holes can be entirely prevented in castings by the addition of manganese and silicon in sufficient quantities, but both of these cause brittleness, and it is the object of the conscientious steel maker to put no more manganese and silicon in his steel than is just sufficient to make it solid. Working with this object in view, he occasionally fails to get quite enough in to make his castings entirely free from blow holes, while one who is simply aiming at solid castings, regardless of quality, gives his metal a dose of silicon which is sure to make it solid; and if there should already be a little more silicon in the metal than he is counting upon, his castings will be beautifully smooth and solid, but brittle and far inferior to those with the blow holes in them. If such castings are to replace iron ones which have broken, they will, as a rule, be good enough; but if they are for new work, and good tough castings have been counted upon, they will be very apt to fail.

Another complaint is that many of the heavy sections on being cut into are found to contain large shrinkage holes. This is true, but most people do not consider the excessive shrinkage of steel in designing their castings, but make them just as if they were to be cast of iron. An iron founder can always get hot metal from his cupola to feed any casting as long as it continues to shrink. The steel founder taps all the metal from his furnace at once, and it is necessary that the casting shall be so designed and the sinking heads so placed that it shall need no more feeding. In order to get such a casting solid it must cool from the bottom up, and the sinking heads must be the last portions to chill or set. In other words, every portion of the casting must have a fluid connection with the sinking head until it is solid. The necessity, therefore, for designing steel castings in such a way that the heavy portions may be cast "up" with sinking heads on them is much greater than in cast iron, for many a section which in cast-iron would have scarcely any shrinkage hole in it, would in steel be so badly shrunk as to be unfit for use. It will follow also that the section of the sinking head must be greater than any portion of the casting to enable it to retain its heat until the whole of the casting is set.

The best results are arrived at when all portions of the castings are of a uniform thickness, or very nearly so. In such a case there is but little danger of shrinkage holes, and the even cooling will, as a rule, cause the casting to retain its shape and be true to pattern; while those in which the sections vary very much in thickness are apt to depart a good deal from the pattern by warping from unequal cooling.

Another and very serious trouble is the tendency which castings have to crack in cooling. These cracks, or "pulls," as they are generally known, take place just after the steel has passed to the solid state and when it is still greatly lacking in tenacity. The contraction of the casting begins very soon after it has become solid, and unless every portion is free to shrink, there may not be strength enough in the metal to overcome the resistance offered by the sand in the mold, and to pull the different parts together, and a crack will open in the hottest or softest part. If there is much variation in the thickness of the metal, it is almost impossible to prevent the formation of cracks where heavy and light sections join. If, on the other hand, the casting is of uniform thickness throughout, such a tendency is reduced to a minimum, as there are no very soft places for cracks to start. All inside corners should have large fillets in them, as such corners when sharp almost always crack open. The tendency of castings to "pull" makes it very desirable that they should be as simple in construction as possible. For instance, it is better to bolt several small castings to one large one than to complicate the large one by casting small projections on it. In case of the built-up structure we know exactly what we have, but when a number of brackets and knobs are cast on, we may never know the cracks or defects until something breaks off.

The principal cause of the difficulties in filling specifications on castings for the United States Navy Department is that all designs are made, not with special reference to avoiding difficulties in casting, but with the purpose of getting the strength needed with the least possible weight of metal. The result is that the castings are often very complicated, and, as each new shape is necessarily an experiment, are very expensive. In many cases, also, there are no doubt shrinkage holes in the centers of the castings, but usually such holes are not suspected until the casting breaks. In the majority of such cases the steel founder has done all he can to prevent shrinkage, but the design of the casting is such as to cut-off fluid connection from the sinking head to some portions of the castings before such portions are set. Steel founders should decline to make such castings as will surely contain serious shrinkage holes, or at least warn their customers that such will be the case, and make an effort to have the design modified. It is a good plan for those not practically familiar with the manufacture of steel castings to submit to those who are, designs of any large or important castings before making the patterns, as in many cases unimportant changes may be made in the design, and much better castings secured. Work will often be much expedited by consulting the founder about the way of making the pattern, as it is often necessary to pour a steel casting in a position very different from that in which an iron one would be cast.

In an earlier part of this paper it was stated that the fracture of an unannealed steel casting very much resembled that of burnt steel. The behavior of an unannealed steel casting also resembles that of an overheated forging. Its chief characteristic is its brittleness when subjected to shock. Hard castings have this property to such a marked degree that sinking heads are often broken off by the shock of chipping off the runner, in which case they nearly always carry a large piece of the casting with them. Such castings, unless containing large amounts of manganese and silicon, become tough and reliable when annealed, and show a fine even grain upon fracture. Another effect of annealing is to equalize the strains of cooling. These strains are sometimes so great as to cause the casting to crack open with a loud report. This happens not only in hard steel, but also in steel low in carbon. As an illustration of this the cracking of a large gear wheel may be cited weighing 8,000 pounds (carbon .34 per cent). The

wheel had been cast several days, and was about half cleaned. It was left in a perfect condition one evening and found next morning with a crack half way across one of the arms.

The following table will illustrate the effect of annealing on tensile strength and elongation:

Carbon	UNANNEALED.		ANNEALED.	
	Tensile strength.	Elongation.	Tensile strength.	Elongation.
.23%	68,738	22 40%	67,210	31.40%
.37%	85,540	8.20%	82,228	21 80%
.53%	90,121	2.35%	106,415	9 80%

In the above table the unannealed and annealed specimens having the same carbon were in each case taken from the same runner of a casting, and very close to each other. On considering this table, the value of annealing becomes immediately evident, as does the absolute necessity for it in case of hard castings. The proper annealing of large castings takes nearly a week, and when we remember that all steel castings are made in dry sand molds, and have sinking heads on them which in most cases have to be cut off in the machine shop, it will be evident that they should be ordered three or four weeks before they are needed.

One more complaint of frequent occurrence is that the metal is too hard or too soft, no specifications having been given except that the castings shall be of steel. In such a case the manufacturer has probably put in the casting the grade of metal which he considered best for the work it was to do, but his judgment will often differ from that of the purchaser. Our experience with steel gears, and especially with roll pinions, is that they do not break, as a rule, but wear out. Consequently we make them hard, pinions being made hardest. The result of this has been that some have complained that they were so hard that they could not be machined. For people who have their machines speeded to cut cast-iron only, they are of course too hard, but if it is desired to get good wear it is much better to slow down the machine and use hard steel for such castings. One objection to hard steel is the tendency which it has to form blow holes, and consequently the strong inducement to add large quantities of silicon and manganese to the metal to make it solid. It is in high carbon steels that silicon is specially objectionable, for while annealing will greatly diminish brittleness due to carbon, it does not appear to have much effect on that due to silicon. Another essential in the production of solid castings of high carbon steel is that the metal shall be very hot. Consequently small castings and those having very thin sections will often contain blow holes, while a thick, heavy casting made from the same metal will be perfectly solid. As large and small castings are usually made from the same ladle of metal, it is considered preferable to run the risk of having a few blow holes in small castings rather than have the large ones unnecessarily brittle. Such blow holes are usually very close to the surface, and may in general be gotten rid of by allowing a little extra metal for machining. In the case of small gearing they show up in the teeth, but our experience has been that such gears wear far better than softer ones, which can easily be made solid.

The proper steel for roll pinions, hammer dies, etc., seems to be that containing about .60 per cent. of carbon. Such castings properly annealed have worn well and seldom broken. Miscellaneous gearing should contain carbon .40 per cent. to .60 per cent., gears large in diameter being softest. General machinery castings should, as a rule, contain less than .40 per cent. of carbon, those exposed to great shocks containing as low as .20 per cent. of carbon. Such castings will give a tensile strength of from 60,000 to 80,000 pounds per square inch, and at least 15 per cent. extension in a two inch long specimen.

Machinery and hull castings for the war vessels now being built for the United States navy, as well as carriages for naval guns, contain from .20 per cent. to .30 per cent. of carbon. The smaller gun carriages are subjected to a ballistic test, in which the casting is pierced by two shots from a three pounder Hotchkiss rapid-firing gun, the shots striking not less than four diameters apart. If the metal shows a tendency to crack seriously, the casting is condemned, as are all others made from the same heat. Castings for the hull and machinery of the ships are subjected to a bending test, in which an inch square bar is bent at right angles around a radius of 1½ inches. If the bar shows any serious cracks the casting is condemned.

In designing machinery, the question often arises as to which will give the desired result most economically, a steel or an iron casting, and is sometimes quite difficult to settle without making both designs and getting prices. If a few facts about the relative size of steel and iron castings of the same strength be borne in mind, they will greatly help us in this matter.

With reference to strength, it has been noted that good castings for general machinery work will give 60,000 to 80,000 pounds tensile strength, and 15 per cent. extension. Where strength and not stiffness is required, a structure of such material will resist a strain of 15,000 pounds per square inch with greater safety than one of cast-iron will resist 5,000 pounds, especially if subjected to shocks. It follows, then, that, if the castings are large, a steel casting to stand the same strain as an iron one need only be about one-third as heavy. In the case of small castings, the use of steel will generally allow us to make them somewhat lighter, but the same proportion will not hold good, as the difficulty of making a perfect steel casting increases very rapidly as the sections become very thin. In general, small steel castings will be found to cost proportionately more, and to be less satisfactory than large ones. They come into use where iron castings will not answer, while large steel castings will often take the place of iron ones on the score of cheapness alone.

The following is a partial list of castings in which steel seems to be rapidly taking the place of iron: Hydraulic cylinders, crossheads and pistons for large engines, roughing rolls, rolling-mill spindles, coupling boxes, roll pinions, gearing, hammer heads and dies, riveter stakes, castings for ships, car couplers, etc.

Perhaps the one class of castings which is of most general interest is that of gearing. A few years ago steel castings were so rough that it was necessary to cut all steel gears, but now this difficulty has been practically overcome, and while they will never be as smooth as good iron ones, uncut steel gears, even of small sizes, are giving perfect satisfaction in many places, and are now used by the Midvale Steel Company almost to the entire exclusion of iron ones.

DISCUSSION.

Mr. Ball thought that a large share of the trouble with steel castings came from those who made the designs. Complicated forms seldom come out good. Designs were often of such form that the man who made the castings had to put in most of his time in thinking how he is to get the patterns out of the sand.

Mr. Davis spoke strongly in favor of the quality of steel castings furnished the Richmond Locomotive Works for the "Texas." They had very few blow holes, and none had been returned. He thought the manufacture of steel castings had arrived at a state of efficiency not generally understood.

Mr. Parker spoke of some work done by Edward Kendall & Sons for the government. The work stood a test beyond the government's requirements, but some very small blow holes were developed, which could readily have been stopped. But the inspector refused to accept the work. He could not see why steel castings, in other ways entirely satisfactory, should be condemned on account of small blow holes that could do no harm.

MR. OBERLIN SMITH: One feature about steel castings that is particularly good is this—their adaptability for shafts with cams on them running against rollers. In many cases where I could not make a shaft of good hard cast-iron stand at all, steel castings, under the same conditions, have lasted for years without a scratch or a mark, the rollers and cams both getting all the time burnished down to a harder and smoother surface. Cast-iron, in the same circumstances, became crushed and rough. I have also found that steel castings in shafts wear a great deal better running in cast-iron bearings than steel forgings of any kind under the same conditions. In the case where a steel forging of all the way from .30 to .50 carbon would cut under the pressure, steel casting would remain perfectly smooth. It seems to have more of a self lubricating character than either cast-iron or steel forgings.

Mr. H. M. Howe did not believe in the necessity of blow holes. No doubt the presence of blow holes indicated the probability of a tough casting, but tough castings could be made that were perfectly sound. I think, he said, that the making of steel castings is a matter of trick and knack a great deal, and one of the most important of these is the one that is dwelt upon so much—providing plenty of feeding for the pipe which it is intended to form. There is one thing that is not mentioned in this paper which I think is a very good plan, and that is to have hot tops to your molds. It is an old trick, but one which has not been put in operation as much as it might be. At the top of your mold place a cap which has been previously heated to a white heat. That is done in Sheffield, England. I favor the feeding by putting at the top of the mold a mouthpiece which is previously very highly heated, so that the metal there will keep perfectly hot and feed long after the metal below has become solid. Another important thing about preventing cracks where the spoke of a wheel joins the rim of the wheel, is casting a fin, which will become hard and strong when the rest of the metal is weak and trying to work apart—a bracket it is called technically.

MR. HAWKINS: I have no desire to blow any more holes in steel castings than are usually found there; but I desire to say that, in my opinion, the engineer who will succeed in correcting the difficulty will have done a good thing. Mr. Gantt's suggestion of leaving a greater amount of metal on fitting surfaces to correct the irregular shrinkage is very well on that character of work, but on a very large variety of work that is not permissible. I had occasion quite recently to attempt to adapt steel castings in a very important part of the machine which required that the castings should be of uniform diameter. We experimented in order to get our patterns just right, and after a good many trials we thought that we had got the thing down very nicely, and being satisfied that we had arrived at that point, we ordered a pretty large invoice of these castings, and to our surprise they were all too small—the shrinkage had gone back to where the original one was—and we were obliged to abandon it. I say there are very many places in machinery where steel castings may be made to serve a very valuable purpose if that unfortunate character in them can be eliminated.

Mr. T. R. Morgan (president of the Morgan Engineering Company) had had considerable experience with steel castings, and got excellent work from several firms. The making of steel castings was a high branch of business, and required good men and high conditions everywhere. The price was an important consideration. The government paid a good price and got good castings. Manufacturers sometimes insisted on low prices, and as a result got poor work. If men in engineering departments could only afford to pay a fair price for steel castings the quality would be much better. It was well known that a good steel casting was worth four times as much as a good iron casting. He believed that, if it were possible for manufacturers to keep a record of how good castings were made, they would get more uniform results. All we want, he said, is good sense; the exercise of practical common sense is a good thing in connection with science, and I think sometimes it is a little ahead of science.

Mr. Gantt closed the discussion, referring, amongst other things, to questions that had been asked. He said: I think Mr. Morgan hit the nail just about on the head. I did not mean to say that complicated castings could not be made. They can be made, but every one of them is an experiment, and somebody has to pay for that experiment, and the ordinary manufacturer won't do it. . . . . Now, about blow holes. There is no more difficulty in getting your casting perfectly sound than there is in an iron casting, but I would rather for my own use have a casting with blow holes than to put the excessive manganese and silicon in to get it solid. If poured quickly, with hot metal, they will nearly always be solid, and a careful consideration of the paper will show that Mr. Howe has misunderstood me; that I did not mean to say that castings could not be made solid without blow holes. With regard to annealing, I did not say anything about that before, but Mr. Kent has asked a question which has brought it up, why it takes a week. Well, it does not take a week to anneal one casting, unless it is a very large one. There is no use in running any risks on castings. They must be heated slowly. They nearly all have a scale on them when they come out of the furnace that has to be taken off, which requires a certain amount of time. With regard to deliveries on castings, that is, of course, a matter with every manufacturer. I do not think that the deliveries on steel castings are much worse than they are on other things. Mr. Howe's suggestion of a hot top for the mold is possibly a good thing. But suppose you have fifty molds to pour from a ladle of steel, it would be a difficult job to have a different top for each one of those molds. Then the question of fins to keep castings from cracking and pulling—everybody does that; not only that, but we put a big fillet in there. I have seen a skin of the casting perfectly solid, which, when it was cut through, showed a hole underneath. Now, you can get good castings if you make the design right. With regard to the strength, I would say that a steel casting, when constructed right, will do three times the work of a cast-iron casting. I don't believe there is any luck in it at all. Now, as to the question of records. That is a thing that requires a higher intelligence than you can find in the ordinary molder. The only way to do is to keep a record of how a casting comes out, and when you get a good one keep that record, and follow the same plan afterwards.

According to the *Chemical Trades Journal*, an apparatus has been patented for subjecting dirty cotton waste or similar material to alternate squeezing and expansion whilst under the action of an alkaline liquid. This process removes the grease and dirt, besides which, such matters may be separately recovered. It is claimed to be exceptionally economical and continuous. The waste is placed in a perforated cage provided with a presser, which is either single or double acting, and capable of a reciprocating motion. A convenient form of double-acting squeezer is a plate, movable on a spindle, fast to the bottom of the cage, and subjected to the power of a lever. A pawl on the plate engages with rack and spindle, so that the pressure exerted primarily by the lever upon the plate is brought to bear upon the waste from opposite sides—say top and bottom—in the direction of the center. The waste is then subjected to the action of an alkaline solution, which saponifies the grease. The latter, as well as the dirt, are expressed by the operation of the presser. The presser is next raised, and a flush of water turned on. This flush has the effect of completing the extraction as well as of removing all alkali. The presser is again raised, and a furthur flush of water applied for the purpose of washing the waste. It is said that this operation of cleaning the waste is very rapid.

Some Shop Notes.

BY FRED H. COLVIN.

In every well-regulated shop there is some method of driving mandrels or arbors in the work without bruising the ends of the arbor. Some use copper hammers, or hold copper plates to strike on, while some use lead in much the same way—and some, I regret to say, very often use the sledge without any protection whatever. In some instances the hide-faced hammers are used, and, after the hide faces are worn out, they are replaced by lead faces, which do very well indeed. For use with the sledge, however (and the hammers themselves are not heavy enough for some work), this is too expensive, and is unnecessary.

In this shop the hammers are cast as shown in Fig. 1, being a plain cylinder of lead with a groove around the center. The handle is shown in the same cut, and is held in place by the ring or collar *r*, that slips over the handles much the same as a blacksmith does his tongs. This handle is bent up of round iron or Bessemer steel, making a very cheap and effective tool that can be used to advantage in any shop not already equipped with this kind of tools.

In this same shop there is lots of pump work, and the pump barrel is in the form of a strainer; at least part of it is perforated for the admission of water, and this must be very smooth in order not to cut the packing of the piston. These perforations are drilled in a jig, and, of course, leave a burr on the inside, which must be removed. This presents quite a problem to remove them cheaply and speedily. When my friend Fred Schrader took the job, he devised a plan that was ingenious and effective, and though it might be altered to run by power, and so be more speedy, it does its work well. It consists of a bar of iron or steel with a forked end which receives a spool, this spool having two grooves to keep the belts separate. The countersink is formed on the end of the spindle for the spools, the whole turning in the end of the bar when actuated by the belts shown. Two sections of the spools are shown, which correspond to the spool in the bar; the end of the belt on *b* is fastened to a spring which brings the spool back to its original position after it has been revolved.

It will be readily seen that, by pulling the loop *l* (which, by the way, can be of any desired length to bring it in convenient position), the spool and countersink will be revolved at the same time, winding up the belt on the spool *b*, the spring reversing the motion and returning the countersink to its original position. This makes a very quick method, and is a great time saver. For small pipe this can be reduced in size quite materially by having the bar round, as shown in the lower part of the same cut (Fig. 2); the countersink can be of the required size, and that is all that need project from the round bar. The bar in the first case is planed out in the shaded portion, to allow the belt to slide freely; and in the round bar shown the side might be planed away, though for compactness the whole thing might be made of a piece of pipe, the belt sliding in the inside, and no planing would be necessary.

The belts, it may be mentioned, are really belt lacings, which answer very well. This, like many other tools, was made temporarily, but worked so well that a new one seems unnecessary. This is often the case with many of such improvements—they are made to try on this job, and work so well they are never built in the best manner.

There is another ingenious device due to my friend that may help some one else out of a bad job some of these days—it is shown in Fig. 3. There was a boss to be faced off in an out-of-the-way place on the machines, and the plan in use was to chip and file it "near enough." The boss was tapped for bolting some part of the machine to it, and this gave an opportunity for the device shown in the cut. It is very simple. A square piece of steel, filed, planed or ground to four cutting edges, and a hole through the center for the bolt as shown. This bolt screwed in the hole forms a guide, a wrench on the square cutter serves to turn it, and the feed is regulated by turning the bolt. A few turns will face the boss all that is required, and a true face is the result, instead of the vagaries of a chipped and filed face. There are many places where this tool can be advantageously used, and it will pay for itself in a very short time.

I was speaking of trouble with belts "creeping on," and was shown a rig for preventing this nuisance and its attendant danger to both men and machinery. The rig is shown in Fig. 4, and will need little explanation to make it clear. A part of the shifting bar is shown with a notch cut in the top, at the right position for stop. A piece of wood nailed to the ceiling forms a guide for a sliding piece that drops into the notch and holds the bar from shifting from belt pressure alone, though it is easily moved, when desired, in the usual way. A weight on the drop holds it in its lowest position, and can be varied to suit the man at the machine.

As many counters are now fitted with iron rods, this will not be applicable to them. Fig. 5 shows how this case is provided for very satisfactorily; five or six years use has proved its utility. For single shift counters, *i. e.*, where no backing belt is used, only one bend will be necessary in the spring; the cut shown is for the double shift. A piece of steel, bent as required, and fastened to the bar by a collar or clamp, is all that is required; care should be taken not to have the spring too short, as there will be too much resistance to the shifter; for double shifts we use about two feet for the spring. No tempering is necessary.

We all know how drawer slides wear from constant use, and how they sometimes drop with their contents, to the disgust of the user of the same. This can be avoided by having the slides and brackets of cast-iron; they don't cost much, and not only outlast the wooden ones, but slide easier, as they are planed on the sliding surfaces. The brackets *b* are fastened to the bench by lag screws as usual, and the slides bolted to the sides of the drawer by cap screws from the inside. This makes a very neat job, as well as being substantial, and the cost is not excessive.

It is sometimes necessary to face a lot of work in the lathe, and have the faces a certain distance from the other parts, such as facing nuts for some special job when all must be the same, and, in fact, there are numerous cases where it is convenient if not absolutely necessary to have some means of stopping the carriage in the same place every time. This can be easily accomplished by the use of the stop shown in Fig. 7, which fastens to the lathe bed over the shears, and can be set in any desired position.

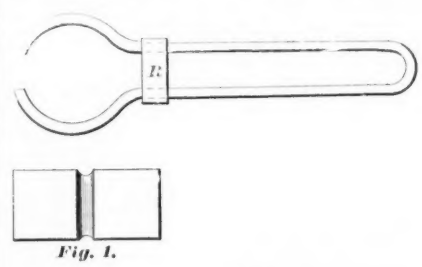
The screw in the top of the stop is useful to graduate the distance without moving the whole clamp; it can be divided to read hundredths, and so be very useful for measuring distances in the lathe. In some cases it may be advantageous to use two, one at each end of the lathe bed, or rather carriage, but for most cases one will be all that is required, but that one will be found useful in many ways that are not thought of at present.

While speaking of stops an ingenious arrangement comes to mind that I found on an old Pond lathe in an out of the-way corner. It was a long lathe, probably twenty feet at the least, and had a device for holding the screw from sagging that may be new to some; it was so arranged that there was always a support at the center (or nearly so) of the screw without any attention on the part of the operator. Two supports, one each side of the carriage, a spring on each end of the carriage, and a pin in the middle of the lathe bed (on the front side) are all there is to it, but the combination is effective. In use, suppose one of the supports is at the middle of the lathe and the carriage at the head, the carriage moves toward the middle, and the support at the head end follows, being held by the spring on the carriage. When the carriage reaches the other support the spring on that end locks into the support and takes it along with it, but the support on the other end soon reaches the pin and is detached from the carriage, remaining in the middle until the carriage returns. It is a very ingenious device, and must be seen to be appreciated; I know of no better one in use at the present day, and this was an old lathe built in the year 1 B.C. by the looks, though the way a lathe is kept has much to do with its ancient appearance. It should be part of the trade to clean lathes and all machinery at least semi-occasionally, for a man is not apt to take much care of machinery that is so dirty you can't see the name-plate, or tell what color it was originally painted.

It is often quite a job to throw belts from one cone to the other on the counter when the ceilings are very high, and several devices for this have been made. Some use a pole with a peg or roll on the top, and it seems to answer in some places, but the easiest rig I know of is that shown in Fig. 8, though perhaps it does not make it quite clear. As the cut shows, there is a ring fastened to the ceiling, and a shifter hangs free from it. By swinging the shifter against the belt from the desired side it forces the belt on or off the cone. A few minutes acquaintance with one will do more to show the value of it than any description can; it will save time and patience, and remove the opportunity for a man straining himself, as is sometimes done.

A friend tackled me the other day in regard to the whistling clause in a recent letter of mine, and said if I had to work with men all around me whistling McGinty or Annie Rooney as loud as possible, I would not be so willing to allow the liberty. Any privilege can be abused, and usually is by some one man, to the detriment of all hands; at the same time the right to whistle should not be taken from the men in general; it is a great companion to many, and when carried on in a civilized manner need not disturb any one. A man should not be allowed to disturb any one else with whistling any more than in any other manner, but the quiet whistlers should not come under the same ban as the disturbers of peace and happiness.

Having a lot of brass plates to face, and not having any way to hold them besides chucking, and then reversing to turn the other side, my friend made another good rig for turning out work in a hurry. He turned up a plate of iron and bolted it to the face-plate, and got it true on the face. Putting a piece of smooth cardboard against the iron plate, he holds the plate against it with the back center, and faces it while it is held by the friction of the plate on the cardboard and the iron plate. When one side is turned or faced off it is reversed, and the other side similarly treated; in this manner the plate is of uniform thickness, and can be quickly turned true on both sides. Cannot this principle be used in many cases where at present the work is carried on under difficulties? And why is not the principle of magnetic attraction used more extensively in this line of work (for iron, not brass)? An electro-magnetic chuck or face plate is easily constructed, and for much work would be of great value. A few cells of closed circuit battery or a line from an incandescent circuit would furnish current which could be applied to the running lathe by brushes similar to the dynamo, and would be of great use in many cases. It is not thought that this would revolutionize the machine business or any branch of it, but we might as well use the applications of electricity as anything else, when it is to our interest to do so. This has been tried, I am sure, though am not acquainted with the results. If any reader has had any experience in this line should like to hear of the results.



SOME SHOP NOTES.

Electricity machinery is being introduced into men of war as rapidly as possible. One firm has eighty projectors on hand, and very many more are being made by other electrical manufacturers. There is not the least doubt that electricity will be one of the most important features in deciding our future battles. Only recently an example of how the bright search light is likely to dazzle the eyes of a belligerent fleet was shown by the fact that a French man of war cut through another ship on account of the dazzling rays of a projector being thrown into the captain's eyes. There would be very few surprises to record in warfare, if a number of projectors were kept going, and one man on the lookout, with such a powerful aid at hand, would be more dangerous than a whole ship's crew waiting in arms for an attack close at hand. Many portable electric light sets have been made, but on ships where steam power is so largely used, it is a very simple matter to get the few horse-power required to drive a search light. Projectors, however, are not only necessary in times of war, but they are a most useful adjunct in times of peace. The time taken between this country and India has been reduced materially by the fact that projectors are used constantly in passing through the Suez Canal. In fact, without these the vessel has to lay to, and perhaps wait as long as eight or ten hours before proceeding. Contractors on the spot

being alive to the necessity of this apparatus, have made it a point to have portable sets at the entrance to the canal for hire, so that those ships not already fitted with projectors can for a few pounds save the expensive delay, and proceed through the canal. Of course it need scarcely be added that large ships, such as the P. and O., and Orient lines, which employ electricity for lighting the cabins, also have projectors for night use.—*Machinery.*

The Pratt & Whitney Co. Dedicate Their New Building.

The following in relation to this matter is condensed from the report of *The Hartford Courant:*

The new building of the Pratt & Whitney Company on Capitol avenue was a scene of festivity last night. The occasion was its formal dedication, with a band concert from 8 to 9 o'clock and a sociable following. The building has been erected for the use of the extensive small tool department of the factory, the employes of which, nearly 100 in number, by permission of the officers of the company, celebrated the completion of the building by giving the entertainment, which proved a perfect success.

By 8 o'clock the two spacious upper floors were crowded with employes of all departments of the company, accompanied by ladies, so that when the grand march was started, shortly after 9 o'clock, it was difficult to move around on the floor. Refreshments, consisting of ice-cream, cakes and lemonade, were served from a stand on the first floor, and above, lemonade booths were erected for the convenience of the dancers.

* * * * * * *

The new building is 300x45 feet, frontage on Capitol avenue facing the south, 120 feet west of Lawrence street. It is two stories and a basement with an extreme height of 50 feet. The material is brick, with stone foundation and slate roof. The timbers are of southern pine, and the floors are five inches thick, with the top layer of one-inch maple. The stone foundation is 30 inches thick, and the brick-work 24 inches on the first story and 20 inches and 16 inches respectively on the two upper stories. Sixty-seven feet from the entrance, running across the building, is a heavy fire-wall 12 inches thick, pierced with doorways which will be closed with fireproof doors.

In the rear end of the basement, which has a cemented floor, is located the wash-room, with four large sinks arranged to give an independent water supply to each man. Individual clothes lockers are provided, one for each operative, with lock and key. Power will be supplied by a seventy horse-power Harrisburg ideal engine, located in the basement. The rest of this part of the building will be used for general storage. All the steel used for making tools will be delivered and cut up there.

The first floor will be occupied by machinery for the general manufacture of small tools, of which the Pratt & Whitney Company make about 2,500 different kinds.

The front end of the second floor, south of the fire-wall, will be used for the storage of finished tools, of which the company carries a stock valued at about $125,000. North of the wall the floor space will be used for tempering, grinding and general finishing. There are two elevators in the building, one at the north end, run by steam, with a capacity of two and a half tons, and a hydraulic lift near the entrance at the south end.

The building will be in charge of Contractor James E. Woodbridge, general superintendent of the small tools department, who is also one of the directors of the Pratt & Whitney Company.

The National Lead Trust proposes to reorganize under the laws of the State of New Jersey, which furnish peculiar facilities for such purposes. The president of the trust is said to explain the previous trouble by the frank statement that there was too much water in the stock, which is one trouble with a good many trusts, and other companies.

Feed-water Heating.

BY W. H. BOOTH.

There is a common impression about that a steam boiler is not an efficient machine. This idea has probably arisen from the fact that even a theoretically perfect steam engine can only realize a small portion of the heat which it receives. This recognized scientific fact has spread to the boiler in men's minds, whereas actually even an ordinary boiler does not reject much more than 30 per cent. of the available energy in the coal.

Apart from loss by radiation and blowing out, there is only one direction in which heat is rejected by the boiler other than the steam outlet, and this is the chimney. If we could ascertain exactly the temperature of the furnace and of the chimney, we should be able to state at once the proportion of heat lost.

If we wish to reduce the waste, we commonly add to the area of heat-absorbing surface of the boiler, and we have known boilers, constructed to utilize waste furnace gases, of as great a length as 60 feet, or even more. Such a length is wrong on at least two counts. In the first place it renders a boiler liable to severe stresses, and rupture of the shell ring seams may be thereby caused should the seating settle even a very trivial amount.

The second reason is different.

The water in a steam boiler has, or should have the temperature of the steam produced, and consequently it is absolutely impossible to reduce the smoke temperature to anything near that of the boiler, seeing that there must be some considerable difference to overcome the resistance of the boiler plates to the conveyance of the heat from the gases to the water. The difference of temperature is similar to the head or pressure required to cause water to flow through a pipe or along a channel. There can be no flow without *head.* A boiler at 350° F. can obviously never absorb heat from smoke at 350° F.

In practice we very soon arrive at that length of boiler beyond which it is not worth while to go for further economy.

English practice fixes the length at about four diameters for stationary work, and internally-fired boilers. American practice seems to tend even to a less ratio.

It is not disputed that a boiler of several hundred feet in length would absorb much more of the heat of the smoke than one of usual length, but very soon it would be found that radiation from the top was in excess of heat received below. As it is, the length of a boiler is made *less* than mere fuel economy would demand, for reasons of space and convenience as well as cost.

Let us suppose a 60-foot boiler will steam at 300° F. Then, allowing a temperature head of 300°, the chimney temperature would be 600°. How could we reduce this latter temperature, and yet preserve our heating surface the same? By a very simple act. We could cut in two the long 60-foot boiler, and make two of 30 feet each, but while in the one containing the furnace, the steam, as before, would be at 300°, it would not do to keep the second half at so high a temperature. On the contrary, we would close every communication between the two halves. Into the second half we would pump cold water, and it would heat up there to perhaps 150°, and this we would pump into the boiler proper, and evaporate it there to steam at 300°.

We have now two vessels at 300° and 150° respectively, and, if we still allow 300° difference between boiler and chimney, we shall get a chimney heat now of only 450° instead of 600°. Here we shall have saved one-fourth of the waste heat, and if this was 30 per cent. the simple division of the boiler into two independent halves will have effected an economy of 7½ per cent. of fuel. This is the primary idea of a feed-water heater, viz., the cutting off of a portion of the heating surface of the hot boiler, and placing it under circumstances where it can better absorb low temperature heat.

The principle might be further extended by dividing the 60-foot boiler into three sections, the first of such length that it would heat the cold feed water to 90° only, the second to heat it further to 200°, and the third or boiler proper to evaporate it at 300°. In this way the chimney would not be over 390°. In practice the principle is only carried to the second stage, which is often sufficient to insure a chimney temperature of 400° only, or even less in some cases.

Apart from economy of fuel, a feed heater helps to preserve a boiler from injury which may be caused by cold feed, and it is a great aid to steady steaming, also. There is one point about smoke temperatures and their reduction which has always been overlooked. Because no thoroughly practical means suggests itself to me for utilizing the fact, is no reason for not naming it. All bituminous coal contains, of course, hydrogen; when burned, this becomes water, or rather highly superheated steam. Now, we all know that a pound of water at 212° contains only about 213 units of heat, and that a pound of steam at 212° contains about 1,178 units of heat, or 966 units more than it would do if reduced another degree in temperature.

In 100 pounds of an ordinary bituminous coal there will be perhaps 5 pounds of hydrogen, and when burned, these 5 pounds become 45 pounds of water, and pass off at the chimney as steam, carrying with them all their heat of evaporation. Ordinarily each 100 pounds of coal evaporates, say, 900 pounds of water. If the heat of evaporation of the 45 pounds of water in the smoke could be taken out of it, we should get an additional evaporation of 45 pounds from each 100 pounds of coal. This is an extra twentieth, or 5 per cent.

There is not much to be saved by reducing smoke temperatures below 500°. Each 100° reduction below say 600° corresponds to, say, the following, on the assumption that at 600° we waste a fourth of the heat.
To 500° = 4%; to 400° = 8%; to 300° = 12%; but to 200° the additional saving is double, for we should save not merely the visible or thermometric heat, but also the latent heat of evaporation, and the chimney would then send forth no steam, but only uncondensable gases, whilst the water would be drained off.

In a considerable experience of feed-water heaters of the vertical pipe type, which consists of a series of rows of cast-iron pipes 9 or 10 feet long, and 4 inches diameter, set in a top and bottom box casting, and so arranged that the feed water passes up all the pipes as it may choose to travel, and is not compelled to travel in any special direction, I have found one prominent cause of wearing out.

The cold feed enters every bottom box, and rises into every pipe of every box. As it ascends the pipes which are stood in the flue, it receives heat from the smoke, and frequently passes out of the top boxes and to the collecting main at 200° or 300° of temperature. Now, it almost invariably occurs that the lower ends of every pipe and the lower boxes are quickly rusted away, whilst other parts are untouched. The reason is simple and obvious. The pipes are so cold at their lower ends, where the cold feed enters, that they condense on their surfaces the steam from out the smoke, and with this steam the acids arising from the sulphur in the fuel and the iron thus moistened rapidly becomes crowded.

If proof were needed of this being the cause, it is furnished by the fact that, if about a sixth of the heated feed water be returned mixed with the cold feed through the feed heater, the corrosion is stopped, because the pipe is then not cool enough on its surface to cause condensation of the steam gases in the smoke.

This return of part of the heated water means simply that to preserve the pipes from corrosion we have sacrificed about a sixth of the economy secured by the feed heater. This is often 12 per cent., and thus we spend 2 per cent. of our fuel to preserve a few pipes. In some steam plants I have in my mind, the amount so spent will figure out at 5 pounds of coal per pipe per week, or, roughly, a ton in 10 years. In England, where a pipe costs from 3 to 6 tons of coal, according to locality and relative cost of fuel, it is clearly a commercial economy to save the pipe in this way, especially if the feed water be good, and free from scale producers, for then the life of a pipe may be almost said to be indefinitely long. Let us, however, suppose that, in place of sacrificing a sixth of our gained economy, we sacrifice a sixth of the pipes. At present a sixth of every pipe rots away and ruins the whole pipe. Suppose, instead of allowing each pipe to rot away one-sixth, we allow one pipe in six to rot away wholly. Then, to save each of this selected sixth of the pipes would demand, by the same figures, 6 tons of coal in 10 years per pipe, and in most cases this is of greater cost than the pipe, for when allowed to rust it sometimes takes 10 years to rust away a pipe to the worn-out condition. It thus appears that, by concentrating the cause of damage upon a few pipes, we can make a true commercial saving, and at the same time we can use the means thus employed as a further step towards economy, for we can isolate a sixth of the feed heater, and turn through it all the feed, so as to warm this above condensation point, and when so warmed the feed passes out the remaining five-sixths of the heater and meets hotter conditions, and does not condense moisture on the pipe surfaces. Of course the first pipes in the isolated group come next the chimney, and the coldest water is next the coolest smoke. The arrangement is valuable as an economy of both fuel and pipes, but experience alone will decide whether it can be made a true economy to reduce smoke temperature below 212° by so dividing down the boiler into sections of graduated reduced temperatures that the final section or two sections will absorb latent heat—condensing the smoke steam to liquid, and realizing the 5 per cent. which bituminous fuel would give. The loss arising from wet fuel would thereby be recovered.

Should it be found to pay—a question too closely connected with that of forced or fan draught to call for attention here—it would appear best that what we may term the condensing pipes of a feed heater should be of some material less readily injured by coal smoke acids than is cast-iron.

Feed heaters are too little employed. Many men will put down an extra 350° boiler rather than add a 150° feed heater to their present plant. These men do not realize the advantage of counter currents.

If they did so they would perceive the folly of increasing heating surface, or rather heat-absorbing surface, in place of adopting the principle of division.

If any one should feel disposed to experiment, let him remember that there is over double as much heat available between smoke at 213° and smoke at 210° as there is in reduction from 600° to 213°. Probably, therefore, in any scheme of sectional feed heating the condensing part may require to be of larger area than might at first appear.

It would not, however, require to be double the area of the previous sections as above, because the condensing pipes, being wet, would act far more efficiently as heat absorbers than hot, dry pipes, and the steam is, after all, only a small proportion of all the furnace gases.

Some day, when draught is produced by fans, we may see the idea carried out, of saving the invisible or latent heat of smoke steam.

Seven large steamships sailed from New York for Europe one day recently—two for Liverpool, and one each for Havre, Rotterdam, Bremen, Glasgow and Hamburg.

Two excursion trains on a French railway recently came in collision, the result being 200 persons killed or injured. This is about equal to anything we do in this country.

Grasshoppers recently held up Jay Gould's special train at a little town in Colorado, compelling side-tracking for the night.

Some Rolling-mill Notes.

BY C. O. SINE.

After a visit to a newly-constructed power-house, with its elegant engine-room and engine finished to match, and supplied with all conveniences that could in any way conduce to the more satisfactory performance of the engine or comfort of the engineer, whose principal duty appeared to be to explain to visitors the engine and the principles of multiple expansion; the dynamo, with its armature magnets and brushes; how the current is generated, and the use to which it can be applied, etc., I came back to the mill with its engines that never saw the inside of an engine-room—in fact, all their conditions and surroundings unfavorable to their satisfactory performance, feeling that we were hopelessly in the rear, so far as engines and machinery are concerned. I have been told that there are rolling-mills that are abreast of the times in engines and machinery. However, that is not the kind I am acquainted with, nor the kind I shall write about.

Convenience in handling stock is often looked after too closely to suit other interests, the predominating idea being that the greater the convenience the less the cost of operating. For this reason we have a muck-iron shear, and an engine to drive it whose environments are bad, especially for the engine, as it gets dust from the road when the wind blows in one direction, and sand from a sand-pile when it comes from another, and ashes from the pit of a heating furnace every time they are taken out, no difference which way the wind blows. Having the sand-pile close to the furnace saves once handling the sand, and having the shear close to the furnace saves once handling of about twenty tons of iron each "turn," or twice this amount daily. The sand would be a small item, but the handling of the iron would save the cost of a small engine every year or two.

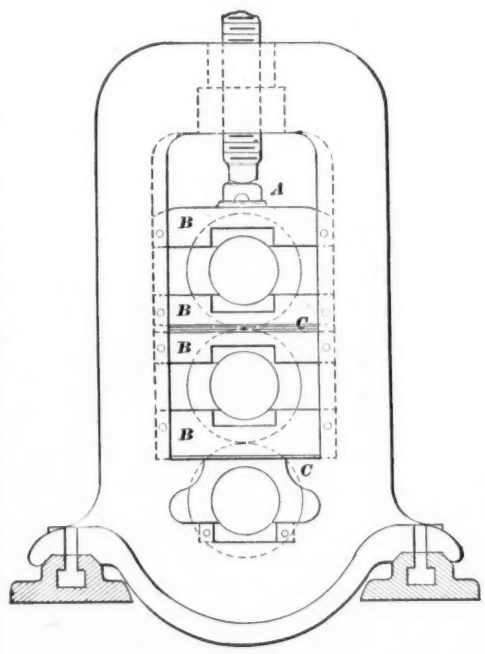
Care on the part of the oiler, or the men who run the shears, would make a pair of guide bars or crosshead gibs last longer than they do, but the oiler gets careless sometimes, and the shearsmen can look on and see "oiron wrought" with a cool indifference that would freeze up a geyser, so under the circumstances I have been making such repairs as will compensate for carelessness. My first deliberate attempt to overcome the oiler's sins of omission (and the managers of commission for putting an engine in such a place) was to make the Waters governor on this engine run dry or otherwise, and not wear out. These governors are of the sensitive, high-speed variety, and the one on this engine is continually on the jump; this because the load is all off and all on at each stroke of the shear, and the fly wheel not being heavy enough to keep the speed regular. The governor wears out first at the pin-holes in the arms, and the feather in the sleeve nut, through which the valve stem passes. The arms I had reamed out, and hard steel bushings put in after they were hardened; the pins were made of the same material and hardened, but the thread on the end was softened, to reduce the liability of breaking; besides, there was no wear on that part of the pin. I had a dovetail cut in the top of the stationary part of the governor, and fitted a piece into it with a slot in the end to receive the feather on the sleeve nut. Both the piece and feather were of steel, and hardened. A new set of gear wheels completed the repairs, which were made a year ago, and it is good for five or six years more.

We have a dozen of these small Waters governors, all running under unfavorable conditions, and as they wear out I shall jewel them as I have the one spoken of, instead of sending for duplicates. Nothing that I have written is to be construed as questioning the merits of this particular make of governor.

Of the parts of the engine that wear out, the crosshead gibs are first on the list, then the guide bars, of which I have made five pairs in ten years.

I have just got a new tub wheel emery grinder for grinding long shear knives, and I think I can lengthen the lives of these guide bars by having the wearing surface cast on a chill, and grinding the chilled surface true on the emery grinder. The little extra cost in making the bars this way will never be noticed, and if they wear as well as chilled iron I have used in other places in the mill work, there can be no ground for complaint. The best material for the crosshead gibs on these bars will be an after consideration.

The relative area and pressure of sliding or wearing surfaces is not a new subject for the readers of the AMERICAN MACHINIST, but the excessively heavy journal pressures I shall relate, I think will be. As an instance, I will say the bearing on our sheet-mill rolls has a projected area of 144 square inches (12 inches square) and that the pressure on this bearing is so great as to break the housings in which the rolls run. The housing is made of cast-iron, is 12 inches thick, and 17 inches wide on each side of the roll, making a total of 408 square inches to be pulled apart. Allowing so low an estimate as 5,000 pounds per square inch, it will require 2,040,000 pounds to break the housing, or over 14,000 pounds per square inch on the bearing. It is not expected that such pressures occur very often, or that they are of very long duration, but that they have occurred there can be but little doubt.



ROLLING-MILL HOUSING.

I do not think that 5,000 pounds per square inch would be a high estimate of the average pressure on these bearings. The rolls run about 40 revolutions per minute, are of cast-iron, and in the best bronze that is procurable, and are lubricated with a patent "hot neck grease," and very plentifully, too.

In "three-high" mills, when the bar being rolled is between bottom and middle rolls, the pressure on the middle roll is transmitted through the "neck" of the top roll to the screw above. This clamps the top roll between the top and bottom brass to the extent of at least 1,000 pounds to the square inch, when on some heavy orders. The boxes are lined with babbitt metal, and are lubricated with a stream of water and a piece of suet squeezed up against the neck.

The sketch shows the housing of a rolling-mill train, *A* being the breaker, *B*, *B*, *B*, *B*, carriages, and *C*, *C*, liners.

I remember well the first set of rolls I saw put in. The first thing to do was to put the boxes in the housings for the bottom roll, then put in the bottom roll, then the bottom carriage which rests on lugs on the housing, then a box in this carriage with liners under it or under the carriage on the lugs of the housings, so that the middle roll when it is put in will be a distance from the bottom roll that will make the iron to be rolled the right thickness. A box and carriage is put on top of the "neck" of this roll, then some liners on top of this carriage, then another carriage and box in it for the top roll, then the top roll goes in with its boxes, top carriage and "breaker" (a piece of cast-iron hollowed out and intended to break before the pressure is so great as to break the rolls), and bring the screw down on the "breaker" about as tight as a man can on a screw 5½" diameter, 1" pitch, with a wrench 3' long. The roller now, with a pair of inside calipers, measures the distance between the rolls, and, if found to be about right, will start up and try a short piece. If it comes out too thick he will take a bar of iron and strike the wrench on the screw with it, and "hammer the screw down" till the iron comes out the right thickness. I had supposed that this "hammering the screw down" would have the same effect on the bearings as keying a crank-pin too tight would have, but it did not, neither did it stall the engine, as I supposed it would.

The practice of "hammering the screws down," although prohibited, is not so injurious as it would at first seem, for it does not increase the friction on the bearings only when the rolls are running empty, except the spring of the liners. The spring of the material above the roll would, to a great extent, neutralize the elasticity of the liners between them while a bar is being rolled.

I have figured the amount of power it would take to drive a pair of sheet rolls, having "necks" 4' in circumference, at 40 revolutions per minute, with a pressure of 720,000 pounds on each of the four "necks," and find with a coefficient of .05 that nearly 700 horse-power would be required. The engine that drives these rolls cannot develop more than 450 horse power, and drives another train of rolls beside the sheet rolls. I think the coefficient of .05 (given by Haswell) about twice too high.

LETTERS FROM PRACTICAL MEN.

The Slide Rule.

Editor American Machinist:

I have read with much interest an article in your issue [July 9,] on "The Use of the Slide Rule," by Coleman Sellers. I fully agree with him in his arguments as to the advantages obtained by the use of the slide rule, and the desirability of young engineers and others applying themselves to its study, having myself always advocated that its principles and use should be taught in every school and college. I think, however, that Mr. Sellers over-estimates the difficulties which stand in the way of the acquirement of a facile use of the slide rule, and I believe that if its study be followed on the lines laid down in my book on the slide rule, which you so flatteringly reviewed in the last number of your journal, that the principles upon which its construction and use are based will be very soon grasped by the mind, and their mastery will then serve as an incentive to further study of this remarkable instrument.

There are many forms and kinds of slide rules, more or less complicated, the same logarithmic principles, of course, underlying them all; but I consider that in this, as in so many other cases, simplicity is the great point to be aimed at. Boucher's Calculator, which I have known at least a dozen years, and of which Manlove is the London maker, and not Stanley, is too complex, and the necessity of having two needle pointers in order to obtain a simple product or quotient is very liable to lead to errors in "reading off" caused by parallax, and also necessitates two operations in order to obtain the solution of the simplest problems. It has the further disadvantage that series of equal ratios cannot be obtained by mere inspection, as is the case with the ordinary Mannheim slide rule. For the benefit of those who desire to purchase the Boucher Calculator, I may say that I have seen it in Messrs. Keuffel & Esser Co.'s store, New York, and believe it may any time be procured there.

I have myself long made use of a small circular pocket slide rule, named Charpentier's Calculimetre, 2½ inches diameter, and ¼ inch thick. This instrument has a graduated slide, so that similar ratios are at once seen with it; it is much easier to work, and the results can be read off with more certainty.

I have, however, no hesitation in saying that the best slide rule for all general purposes is the Mannheim slide rule, which may always be had at the store named, and on this one I can ascertain the horse-power of a steam engine with but three operations, whereas Mr. Sellers' mode as given necessitates nine. This multiplicity of operations magnifies any errors which may be made in the setting of the pointers, and consequently would produce a considerable error in the final result.

For the other example which Mr. Sellers gives, namely to find the number of cubic feet of water per horse-power for any given fall, I require one setting only, whereas his method as stated requires five different operations.

I am patenting at the present time a new slide rule which will facilitate still more the solution of many intricate problems by means of this excellent instrument, as with my invention I can perform with one setting of the slide two consecutive multiplications or divisions, so that formulæ like $\frac{a \times b \times c}{d} = x$, or $\frac{a}{b \times c \times d} = x$, may be much more promptly solved than by any other calculator. Simplicity, I may add, is its greatest feature.

I shall be very happy, should you or your readers desire it, to give briefly the methods by means of which I obtain the results named, and that with so few operations. Many of them are, however, contained in my book on the slide rule, and some shorter and quite new methods will be given in my new book, so soon as the necessary arrangements are completed for placing my new slide rule on the market. WM. COX.

"A New Radial Drill."—Magnetism in Drills.

Editor American Machinist:

Under above caption you describe a drill (see issue of July 23) which has as a direct attachment an emery wheel. Though not in the habit of criticising manufacturers, this seems to me a very undesirable feature on such a machine, for two reasons. The first of which is that emery dust not only may, but will find its way into the journals of the drill. And the second is that such a wheel as illustrated, without water, is not the very best thing for the usual drill hand to grind drills upon.

If Mr. Colvin wishes to prove or disprove the theory that magnetism is heat or is due to heat, he will find the means very close at hand. Let him take the temperature of his drill when it begins to attract the chips, and then heat another non-magnetized drill to the same temperature by fire. I think he will find that the magnetism is due to friction. As for example, a twist drill will usually attract chips the whole length of their sides which come in contact with the chips; while in a flat drill the magnetism is usually confined to the point or only where it rubs against the metal. E. W. R.

Shop Devices and Methods—The Industrial University—A Criticism.

Editor American Machinist:

Mr. Webster gave some interesting illustrations of counterboring tools, and I wish to add another, which I made and used about three years ago, for counterboring holes for screw heads in sheet metal shear knives. The knives were all steel, tolerably hard, and, as it was inconvenient to anneal them, the counterbore got dull very soon. I then made one on the shell reamer plan, Fig. 5 [page 7], so it could be taken off to be ground. The shank can be made of iron, and the point which enters the hole case-hardened, thus making a cheap and serviceable tool.

Fig. 1 shows an arrangement of a star feed for boring taper holes with a compound rest. The mandrel is fitted to the taper hole in the spindle to drive it, and it has

fitted to it an adjustable head, held by a set-screw, which carries the tripping rod that operates the star. This is doubtless an old device, but it is not in common use and may be new to many of your readers.

On many lathes the compound rest has the outside of its base turned concentric with its center pin, and it is sometimes graduated in degrees, but often it is not. A very handy way to set it for boring or turning tapers is to take dividers and make a circle with a diameter equal to the diameter of the base of the compound rest, and with this center for the apex of the angle, make two straight lines at the desired angle, as shown in Fig. 3, where the angle is 6 inches to 12 inches, and *b* is the diameter of the rest base. The rest base should have two reference marks on it, one showing when the rest is standing at exactly a right angle to the center line of the lathe, and another showing when it is parallel with the center line. When setting to bore a taper hole the rest should be swung around until it is parallel with the lathe center line, then set the dividers to the distance *a*, Fig. 3, and place one point on the reference mark on the saddle at *d*, Fig. 1, and swing the rest around until the reference mark on the base of the rest is even with the other point of the dividers, and the rest will be at the desired angle.

Fig. 2 shows a diagram for getting the angle of the face of a bevel gear, where the center for the base line is at the apex of the pitch cone. If the reader fully comprehends the idea, he will apply it easily to any kind of a taper job that may come along.

An angle or knee plate is a very convenient thing, if not an actual necessity in doing work on a drill press; but one of the disadvantages of it is that, no matter how small the piece that may be bolted to it, the angle plate must be bolted to the table or it will tip over when the drill is forced into the piece being drilled. This is considerable objection, as it takes more time, and then it is more difficult to adjust around to the exact position under the drill point. To obviate this I propose making them as shown in Fig. 4, the piece being drilled to be bolted to the face *C*. The extension under the work might have slots for bolt heads to be used to assist in holding the work. This is an angle plate that will stand alone with any kind of a job that does not extend beyond its base, and all that is needed to hold it is a pin in the table to keep it from turning, and even that would not be needed on small jobs.

"A Mechanic" shows a device for holding up the planer tool while the table is running back; one using the same principle was shown in a previous number of the AMERICAN MACHINIST, but the cheapest and first one I have seen was used by a machinist where I served my apprenticeship; it was made of a stiff piece of old belting tied to the back of the tool with a shoe-string, Fig. 6. It answered the purpose perfectly, and I remember at the time I was struck with the ingenuity and simplicity of it.

The communication by Prof. Sweet, in reply to the various criticisms of the industrial university scheme, is very interesting, and, with the explanations he therein offers with regard to the teaching and lecturing part of it, I am heartily in favor of the whole plan, and I hope to see it in operation some time, with a leading spirit at the head who will be capable of giving it a fair trial.

In your answer to Question 276, in the June 18 number, you attribute the failure of the water to come out at the other end of the pipe wholly to the friction of the water against the sides of the pipe. In this particular case I cannot see why friction should entirely prevent the water from coming out, nor can I see why it should in any case where time enough is given for the water to get through, no matter how small the aperture through which the water must pass. To illustrate this: Suppose you have a vessel containing water, and you take another with a minute leak in the bottom, and immerse it almost to its full depth; if it is given time enough the water will come to the same level in both vessels. Go to a sandy beach, and dig a hole some distance from the water, and deep enough to be below the level of the water, and it will fill up until it is level with the main body of water, in time, and surely if friction would prevent it there would be plenty in getting through the large body of sand. According to the way your correspondent states the question, I think he had a real air-trap, and if he does not know what that is, an explanation of an air-trap would be an appropriate answer to his question.

BELL CRANK.

Magnetism in Drills.

Editor American Machinist:

I think Mr. Colvin's drills are not influenced so much by the different metals on which they are used as by the position they occupy, in use or at rest, with respect to the magnetic meridian, or, more properly, with respect to the direction taken by the dipping needle. It is pretty generally known among the iron shipbuilding fraternity that a ship becomes magnetized during the course of construction, the polarity and strength of magnetism depending on the ship's position, the theory being that the process of riveting gives the molecules a shaking up, and when they come to rest they arrange themselves in accordance with the influence of the earth's magnetism. It is also said that the local magnetism in a ship may alter while she is at sea, from the jarring of the engines, and shock from waves, if she is heading in a different direction from that she occupied in the shipyard.

The same theory ought also to apply to machine tools, only in a greater degree, as they usually stand in the same position for a long period. I have a small bench lathe that stands tail to the north, and the bed is polarized tail north and head south. I also have an assortment of tool-steel standing in the corner of the room, and these bars more nearly approximate the direction of the dipping needle than does the lathe bed. I find that those bars that haven't been turned end for end for some time are polarized with their upper ends south. A drill press ought, theoretically, to be polarized with its upper end south. My drills I keep standing vertically in a rack, points up, and this by itself ought to polarize them with their points south, but when chucked in the lathe and jarred or chattered, the points ought to be north, while if the work is chucked, the drill point would become south from this cause alone, being used about equally each way. These two disturbing causes should about offset one another, and the drills have the same polarity as they would receive in the rack. And this I find to be the case—points south.

It would be interesting to know in what position Mr. Colvin's drills were when used, and also when at rest.

WALTER GRIBBEN.

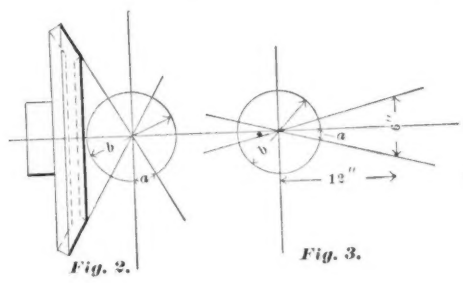
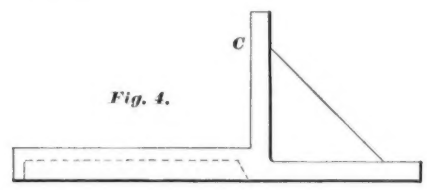


Fig. 2. Fig. 3.



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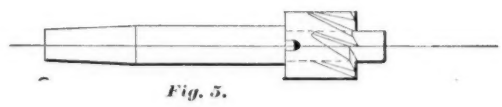

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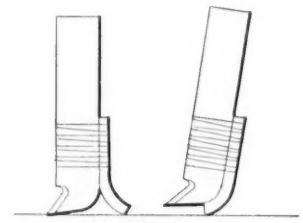

Fig. 6.

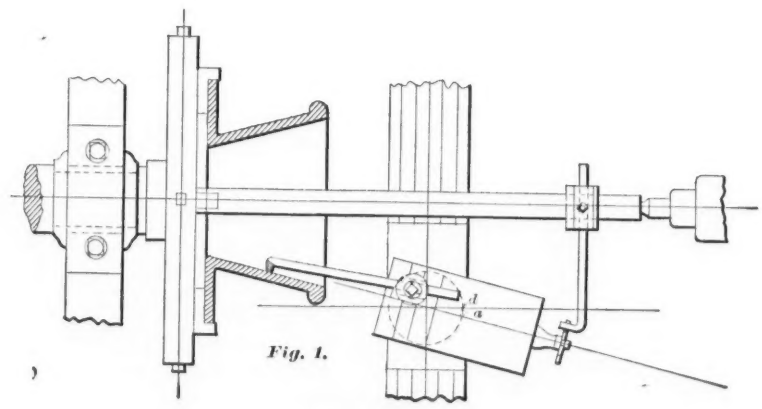

Fig. 1.

SHOP DEVICES.

In Favor of Piece-work Plan.

Editor American Machinist:

I have read with great interest the discussion of the different plans of working, viz., day-work, piece-work and the premium plan, at the meeting of the Mechanical Engineers, at Providence. But of all the plans that have been brought up, I think that piece-work is more satisfactory to the men and the proprietors, providing the price agreed upon is adhered to. I will try and state my reasons for saying so. It has come to pass in these days that every molder that is working by the day in a shop must receive the same pay per day, and no more; I know it must grieve a good man to be working alongside of a man that cannot make a decent washer, and still he gets the same pay per day as another; but by putting them at piece-work, that will fetch out the qualities of the men, and put them on an equal footing, so then they will be paid according to their ability.

There is a man making so many molds for a day's pay, say six, and the man gets $3 per day; that would be equal to 50 cents apiece. Now we will say that the man does not hurt himself by making six, and the proprietors make a fair profit from the man's day's work, providing that the work turns out all right; but if one is bad (and this is where the piece-work plan turns out to the advantage of the proprietors) the firm is 50 cents out on that man's day's work.

At one time, being in a hurry for some castings that a man was making by the piece, I asked him if he could not make more of them, as they were wanted very much; he told me that he could, but it would not do, as the people in the office would cut the price down if he made over $3.50 per day. I knew that the man could make $5 per day on the job.

The greater part of the trouble with the piece-work system is, the workman takes a job, and if he gets fair wages at it the proprietors will cut the price down till there is nothing left for the workman. I think that is the reason that piece-work is not received with more favor by the men. Some time ago I heard a foreman telling about a firm that he worked for once. The workmen made very fair pay, and the proprietors thought that they were making too much, so they told the foreman that he would have to cut them down. "All right," says the foreman; and he cut them down. The next pay day came around, and the pay roll was the same, so the foreman was called into the office to explain how it was that the men received as much pay after the cut as they did before. "Well," the foreman says, "the men before the cut did not commence to work before 7 o'clock in the morning, but now they begin about 6 o'clock. "Well," says the proprietor, "they are getting too much; we will have to cut them down again." "All right," says the foreman, "down they go." The next pay day came along, the pay roll was the same. The same operation gone through by calling the foreman to the office. "I can't see how it is," says the proprietor; "here the men have been cut down three times, but still they receive the same amount of money every pay day; we will have to cut them down again." "All right," exclaims the foreman, "I think that you have got them this time, because the men used to take out their castings every night, and mix up their sand ready for the morning, and as soon as it was daylight they were all in the shop working away, but, as I said before, you have got them now; they cannot do any more."

On the other hand, I have seen a firm let a man go that did about twice as much work in a day as any other man, because he asked for a quarter of a dollar a day more. The excuse of the firm was: If we give it to you all the rest of the men will want it; but I fail to see the sense or reason in it—if the man is worth it, give it to him.

There is another drawback to the piece-work system, and that is, for instance, a foreman takes hold of a shop that is all day-work; the proprietor wishes to introduce piece-work; it is hard work to do such a thing in an old-established foundry, but at last the thing is done, and the system works along smoothly. The proprietors take a look through the foundry now and then, and they find that the foreman has nothing to do but stand around, so they think that a cheaper man can do that job, and they will find some excuse so that they can turn him off and get the cheaper man.

The premium plan *may* be all right, but I don't think that it will work with the average run of men, because, in the first place, if a man is getting $3 per day, or 30 cents per hour, he will not be willing to work for $1.50, or 15 cents per hour, and that is what it amounts to, according to my idea.

But if the man got 20 cents, and the proprietors 10 cents, I think that it may work better, as then the man would be getting more money for his work.

THOS. WATHEY.

The wise policy of the State in being liberal with the Ohio State University, of Columbus, Ohio, appears to be rapidly building up that institution into one of the prominent schools of engineering and science in the country. The range of instruction includes courses in arts, philosophy, modern languages, science and agriculture; in civil, mechanical, electrical and mining engineering, and in veterinary medicine and pharmacy. Two new buildings are to be erected the coming year, at a cost of $150,000. Three new departments have just been created, and two more professors in agriculture and botany are soon to be added, making the total number of teachers forty-five.

The Southeastern Railway of England has a savings institution connected with its management, and it is said that more than four thousand of its workmen are depositors.

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Chief of the Machinery Bureau.

In our issue of July 23 we had something to say as to what seemed to us to be the proper course to be pursued in the selection of a chief of the machinery bureau at the coming Columbian Exhibition. About the time our article was published, Mr. James Allison, of Cincinnati, was appointed to the position. Mr. Allison, according to a published account, the correctness of which has been certified to us, was apprenticed early in life to a plumber, and after serving one year of his apprenticeship, went into the army, finishing his term of apprenticeship at the close of the war. He became a foreman plumber, and finally a partner, afterwards going into the business for himself—a business in which he is now interested. He is president of the National Association of Master Plumbers; president of the Ohio Mechanics Institute; member of the Board of Commissioners of the Cincinnati Industrial Exposition, and in 1888 was elected president of this board. He took a prominent part in the work connected with the celebration of the Ohio Centennial celebration.

It is hardly necessary for us to say that our opinion as to the kind of man that should occupy this position, as expressed in the issue of this paper referred to above, has not changed. By comparison of the above record with those views, our readers can readily perceive whether or not the appointment meets our views as to what it should be, for they now know all of Mr. Allison that we ourselves know.

His election to the various positions named above indicates, of course, that, in Cincinnati, where they certainly know what executive ability is, he is considered to possess it in a marked degree, and it is this quality which is most needed for such a position as that to which he has been appointed. We must confess, however, that it is a matter of some regret to us that this executive ability was not found associated with other and different experience and training than that of a plumber, no matter how excellent a one. In other words, we would have much preferred that the man selected should have been identified with machinery, and that he should have been trained in a machine shop rather than in a plumber's shop.

This is not to be taken as a prophecy that Mr. Allison's management will not be successful, for we expect that it will be so, and can be depended upon to do anything in our power to make it so. Nor do we mean to say that we think the selection is not the best that could have been made under the circumstances; we shall take it for granted that it is so. But this does not in the least lessen our regret that some machinist and mechanical engineer could not have been selected. Possibly none were available; but if there were, it is of course all the more creditable to Mr. Allison that he, not being a machinist or mechanical engineer, was yet considered to be best qualified for the position.

The Trouble in the Tennessee Mines.

In our issue of last week we briefly referred to the trouble between the free miners of Tennessee and the authorities, in regard to the employment of convict labor in the mines. At that time we alluded to the victory of the free miners in compelling the removal of convict miners from certain mines, and stated, in effect, that the miners would do better to await the action of the voters of the State before resorting to violence. Subsequent proceedings go to show that the miners have acted with rare good sense in permitting the convicts to return to work pending the action of a special session of the legislature of the State. Now it seems to be the opinion that the legislature will not undo the legislation that is obnoxious to the miners, and the belief is that there will be further trouble. Our counsel would be that, in case this is true, the miners appeal to the ballot-box on this issue, with a view to getting a popular expression of opinion on the subject. This, it seems to us, is better in every way, than to bring about further conflict.

It is true, probably, that the miners cannot put speakers in the field, in the election of a new legislature, to present their views, but they can probably reach the people in some way—through the press, and in other ways.

The fact that an isolated part of the people of a State cannot reach the people in a political campaign doubtless has a good deal to do with outbreaks like this in Tennessee. But it is generally a question of patience. Better await the slow action of the law than resort to violence. Everything will move more smoothly afterward.

If the people of Tennessee find trouble in the execution of their laws, it will be wise for them to consider whether the laws enacted are just. It is difficult to execute unjust laws, and this difficulty is, year by year, increasing rather than decreasing.

A very good illustration of the reason why it is difficult, if not impossible, to make work carried on by the government as efficient and economical as that done by private enterprise, is shown by the case of Lieut. Meigs, who has for years made a special study of ordnance matters, and has come to be regarded as an authority in that line. On being examined, with a view to promotion, it was discovered that he was color blind—a defect that in no way interfered with his work, and which he was in fact ignorant of himself up to the time of the examination. The law declares that any physical defect whatever shall cause retirement, and in this case, instead of being promoted, Lieut. Meigs is to be retired, notwithstanding it was recognized that his color blindness would never stand in the way of his efficiency in his particular line of work.

A private concern under the same circumstances would have been able to retain the services of so valuable an expert. Common sense and judgment would have been applied to the case, which, of course, is impossible where iron-clad rules must be observed without regard to special circumstances. It is not probable, however, that matters can be improved in this respect in any department of the public service, because there must be laws governing all such things, and, of course, those laws must be observed, whereas a private individual is able to be governed by the dictates of good judgment in every instance, and to decide upon the merits of the question, without regard to other similar cases or precedents.

It is announced that the Erie road has formally decided that it will hereafter recognize the right of the public to know the particulars regarding accidents which may happen on its road, and that from this time on, representatives of papers will be given reasonable facilities for obtaining accurate information for publication as promptly as possible. We think this is a wise decision, and that, in the end, other roads will see that it is to their advantage to take the same course, instead of, as now, ordering every employe to refuse all information. Something is bound to be published regarding every accident of consequence, and it is far better that the road should assist, so far as possible, in placing strictly accurate information before the public. Those who have friends traveling, and who may be involved in some catastrophe, have a right to know the exact facts as quickly as possible. At the same time, it would seem to be proper that the representatives of any paper making a practice of publishing sensational and highly colored reports should be barred out. The exact truth, as near as it can be told, is what is wanted.

The West End Railway Company of Boston is the largest operator of street railway lines in this country, and, as it uses both horses and electric traction, has a good opportunity for making comparisons. The June statement of the operations of the road gives in full detail the business done by each kind of cars, with the revenues, cost and net earnings. The operating expenses per cent. of earnings were for the electric lines 47.7, and for the horse lines 66.7. The earnings per mile run were for the electric 42.71 cents, and for the horse 36.85 cents. Expenses for motive power were for the electric 7.31 cents per mile run, and for the horses 10.83 cents. Net earnings per mile run for the electric were 22.34 cents, and for the horses 12.27 cents. The electrical papers are calling attention to the fact that this is a remarkably good showing for electric power, and we entirely agree with them. It is to be remarked, however, that it is also a remarkably good showing for steam engines as against horses for furnishing motive power, even when a considerable proportion of the power developed by them is lost by its subsequent transformations.

One of the oldest co-operative establishments of the country has announced its purpose to wind up its affairs, and close out business. It is a foundry in Somerset, Mass., which was organized October 18, 1867, through the efforts of the founder of the Iron Molders Union, Mr. William H. Sylvis. This company is one of a number of similar ones established about the same period, all the others having either gone out of business or modified their organizations to such an extent that they could no longer be called co-operative. The Somerset company has paid 10 per cent. dividends at irregular intervals, and no specific reasons are given for its retirement from business.

Dayton and Springfield, Ohio, which are supplied with natural gas by pipe lines laid from the gas regions controlled by private corporations, have been notified that, owing to an alleged falling off in the supply of gas, its price will be increased. In the case of Springfield, at least, the price at which it is now proposed to supply the gas is above the limit fixed by agreement between the company and the city authorities at the time the franchise was granted.

Literary Notes.

WORLD'S FAIRS FROM LONDON, 1851, TO CHICAGO, 1893. By C. B. Norton.

This is a book in which a condensed illustrated history of all the important international exhibitions since 1851 is given, closing with information regarding Chicago and the fair to be held there. The illustrations are numerous and good, and include views of the park in which the fair is to be held. The book contains 93 pages, is bound in paper and published by the Milton Weston Company, Chicago. We are not informed as to its price.

The article in the *Stevens Indicator* for July that will be most interesting and instructive to most of our readers is the conclusion of a lecture by Professor Coleman Sellers on "The Machine Shop." It is full of the most valuable suggestions in regard to the management of shops and manufacturing business generally, and could have been delivered only by a man thoroughly familiar by practical experience with the subjects discussed.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(344) C. A. W., Tampa, Florida, writes: Please give me through your columns the names of good books treating on steam pumps. *A.*—Practical Hand-book on Direct Acting Pumping Engine and Steam Pump Construction, by P. R. Bjoerling, may suit you. There are many other good works treating on this subject; it is difficult to make a selection for you.

(345) W. K., Cleveland, O., writes: Please inform me through your columns how to compute the pressure per square inch on stay bolts. Please give an example. *A.*—See answer to Question 15, in our issue of January 19, 1890.

(346) G. S. B., Middletown, N. Y., asks: What size wrought-iron (commercial size preferred) should be used to make hangers for supporting 2″ pipe, filled with water? The pipe is to be held against vertical posts, 2″x4″; the hangers are to be made of a hook form and bolted to the posts by two ½″ bolts. *A.*—We should use 1″x⅛″ iron for hangers placed about ten feet apart.

(347) F. M., Matteawan, N. Y., writes: I would like to inquire about how much water would be required for a boiler 30 inches diameter, 60 inches high, having a furnace 24 inches diameter, 27 inches high, 42 tubes 2 inches diameter 34 inches long, to run an engine with cylinder 6 inches diameter, 6 inches stroke, the boiler pressure will be about 60 pounds. *A.*—The quantity of water will depend on the horse power developed by the engine; for 7 indicated horse-power you will require about 300 pounds of water per hour.

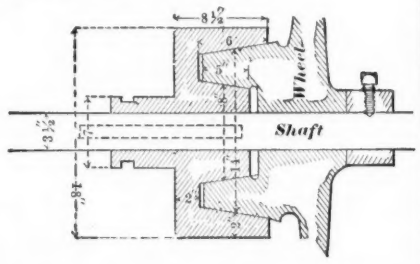
(348) J. C. R., Jeffersonville, Ind., asks: How, and how much can the atmosphere be compressed? And in what proportion does the power of compressed atmosphere stand to steam power? *A.*—The air is generally compressed by the means of a piston working in a cylinder; in fact, these are some of the principal parts of an air compressor built specially for the purpose. The extent to which air may be compressed in the useful arts is limited only by the strength of the compressor, and the tightness of the parts in which the air is confined. The energy which compressed air can exert is the same as that of steam of the same pressure. 2. Are there any engines which run with compressed air? *A.*—Yes.

(349) A., Chicago, Ill, writes: Please find enclosed a cut of heater. I wish to know the proper way to compute the horse-power of the same. The diameter of outer shell is 24 inches; height, 8 feet; diameter of inner shell is 20 inches; height, 6 feet. The inner shell contains 13 flues, 2 inches diameter; filtering chamber, 12 inches diameter and 2 feet long. *A.*—The custom is to allow 1 square foot of heating surface per horse-power. According to this unit of measurement we should rate your heater at 72 horse-power. Manufacturers of feed-water heaters of special design generally determine by experience the unit of measurement. You may require a little less than 1 square foot of heating surface per horse-power.

(350) P. J. F., Beaver Falls, Pa., writes: I have a vertical compound non-condensing engine to design, and the following conditions arise: It must be run at 400 feet piston speed only; initial steam pressure, 100 pounds. A throttling governor will be used, and the cranks must be placed at 90 degrees, and the engine is to develop 85 horse-power. I have selected 12″x20½″x16″ stroke as the size of the cylinders, and laid out a set of cards which I enclose. I intend to cut off at ¼ stroke in the high-pressure cylinder, and about ⅝ in the low-pressure cylinder, so as to get about equal work out of both cylinders. I have assumed the clearance to be seven per cent., but I do not know whether I can get down to that. Please inform me if the proportions of the cylinders are correct. *A.*—The proportions of the cylinders are good, but they will develop a greater horse-power than 85. It seems to us that cylinders 10½″x18½″x15″ are large enough for the required horse-power.

(351) W. H. T., Amsterdam, N. Y., writes: Please inform me, or give me a receipt for bluing a small spring by a chemical process, as we have a quantity of these to do, and wish to do it as speedily as possible. *A.*—There are various processes, but in order to produce the best results it is necessary in them all that the surface shall be made thoroughly clean. If a piece of highly polished steel is simply touched with the uncovered hand there will be an impression left upon it which will show after it is blued, unless the imperceptible stain is removed before heat is applied. One of the processes is thus given: First, coat lightly with linseed oil; then sift dry hard wood ashes over the springs with a sieve until they are covered; place them in a furnace, and heat them until the color begins to change to a blue, after which they are cooled in the air, the ashes brushed off, and they are placed in a wire basket and immersed in sperm oil; when taken out they are washed in a solution of soda, to remove the oil. The linseed oil causes the ashes to stick. The process is called "*ash bluing.*" By coating them evenly with ashes they are not exposed to the direct access of air, and oxidation takes place slowly and uniformly. For further information, see "Practical Details of Bluing," by B. F. Spalding, in our issue of October 2, 1890.

(352) W. H. N., Preston, Minn., asks: Is it a fair test and a safe one on a boiler to apply a full cold-water pressure? Should not the boiler be fired up and the water hot when the hydraulic test is applied? And are not the boilers injured by a strictly cold-water test? *A.*—We prefer hydraulic tests with warm water. Although cold water is frequently used, there is danger of injuring the boiler with it. We believe that the best way to test a boiler is by means of an injector which takes steam from another boiler. This will raise the temperature of the cold water, previously put in the boiler, sufficiently high for all practical purposes. Sometimes the boiler is filled with cold water and every outlet closed, and a light fire started. As water expands about $\frac{1}{24}$ in volume in rising from 60° to 212°, the rise of temperature, as the water becomes heated, will cause a corresponding increase of pressure, and from the regularity with which the pressure rises, the condition of the boiler can be decided, any jerks or starts of the steam gauge hand being considered to denote weakness, the soundness, on the other hand, being indicated by the steady rise of the pressure gauge. In using this method of testing, there will be some difficulty in regulating the fire so as to impart the heat in a uniform and regular manner, and also some difficulty in maintaining the temperature for any length of time exactly at the point to correspond with the desired pressure. The use of this plan would, of course, forbid the examination during the test at least of the heating surface. When cold water is used, the usual method of testing boilers is to fill them and produce a pressure within by means of a hand force pump. All the openings are securely closed. The safety valve, which is loaded to the required test pressure, is kept raised till the boiler is completely filled with water. Then, after closing the safety valve, the pump is worked till the steam gauge indicates the test pressure. The pump should deliver only a small quantity of water at each stroke, and must be worked carefully, as the pressure rises, in order to avoid jarring the strained boiler and producing a sudden rise of pressure beyond the limit of the test pressure. Some engineers close the safety valve before the boiler is quite full of water, and so retain a quantity of air to act as a cushion when the pressure is applied by the pump; but when this enclosed air escapes through leaky seams and rivets, no marks indicating such leaks are seen on the plates.



(353) H. A. R., New York, writes: Enclosed find sketch of a cone friction clutch. Please inform me if it will transmit the same horse-power that can be transmitted by the 3½-inch shaft; and what force will be necessary to force the two parts together without having them slip? Material to be of cast-iron. I cannot use the forms on the market, on account of space. Any improvements you may suggest will be thankfully received. The mean diameter of the wheel cone is 14 inches; angle of cone with central line shaft is 9 degrees. *A.*—The horse-power which can be transmitted by the shaft will depend on its speed, which you have not given. Assuming that the shaft makes 120 revolutions per minute, then the horse-power it will transmit may be found by the following formula:

$$H = \frac{D^3 \times R}{90}$$

in which H designates the horse-power, D the diameter of the shaft in inches, and R the number of revolutions per minute. Substituting for the symbols their values we have $H = \frac{3.5^3 \times 120}{90} = 57$, the fraction being neglected, or $57 \times 33{,}000 = 1{,}881{,}000$ foot-pounds. But this is also the energy which must be exerted by the clutch. Since we have assumed that the clutch makes 120 revolutions per minute, the energy which must be exerted during one revolution is $\frac{1{,}881{,}000}{120} = 15{,}675$ foot-pounds. The mean diameter of the conical surface is 14 inches; the corresponding circumference is 3.66 feet; hence the force acting on this circumference, or at the mean radius of seven inches, will be $\frac{15{,}765}{3.66} = 4{,}282.7$ pounds. Now let the force acting in the direction of the shaft be designated by Q, and the force acting at the mean radius by P, which, in the case before us, is 4,282.7 pounds; then for computing Q we have the following formula:

$$Q = \frac{P \times \text{sine of angle of clutch}}{\text{coefficient of friction}}.$$

It must be here remembered that the angle of the clutch is not the angle at the vertex of the cone; but it is one-half of this, or, in other words, it is the angle formed by an element of the cone and the shaft. Also, the coefficient of friction varies with the condition of the surfaces of contact; when these are dry, the value of the coefficient of friction will be about .45, and when oiled about .1. Adopting .45 for the coefficient of friction, and remembering that the sine of the angle of nine degrees is .15, then using these valves in the formula, we have

$$Q = \frac{4{,}282.7 \times .15}{.45} = 1{,}427 \text{ pounds},$$

which must be exerted in the direction of the shaft to hold the surface in contact without slipping. This result indicates that the clutch is not large enough for a 3½-inch shaft running at the assumed speed. It will be noticed that we have not taken into account the inner cone, which, although useful for reducing the wear, will not, in our opinion, add much to the power of the clutch.

(354) W. H. P., Peterborough, Canada, writes: We have been building boilers for the last thirty years, and never had any complaints. We built two boilers some few months ago 54 inches diameter, 25 feet long, each with two flues 16 inches diameter, shell, $\frac{5}{16}$ inch; heads, $\frac{8}{8}$ inch thick; rivets, best English iron, ¾ inch diameter; pitch of rivets, circumferential, 2⅛ inches, single riveted; longitudinal seams, double riveted, pitch, 2½ inches; flues of ¼ inch plate, rivets, ⅝ inch diameter; pitch, 1⅛ inches, single riveted; holes good. Boilers of Scotch steel, best brand, and were what we consider well built. Now we had a telegram from our customer saying that the rivets in the boiler are leaking badly, although they were tight for some days at first, carrying 60 pounds of steam; fuel, soft coal; water excellent. Now these boilers were tested before leaving the shop to a hydraulic pressure of 100 pounds, and were tight, and the gauge stood at that, and we passed them as first-class. From our experience, if a boiler is tight at first, and stands at the required pressure, it should be all right. Can you give us any reason why they should leak? *A.*—New boilers often leak at the seams when set to work after being tested and found tight at the maker's. This may be due to rough usage in removing the boiler and fixing it, or to the expansion of the plates in actual work being different from that produced by the test. A difference in the nature of feed water has sometimes a remarkable effect in making boilers leak at the riveted joints below the water line. A boiler may be quite tight with one kind of water, and yet leak badly with another kind. When this is the case, it is generally found that a comparatively pure water has been changed for brackish water, or one containing much carbonate of lime, the use of which is attended with a higher temperature of the furnace and flue plates, and consequently a greater local expansion. Leakage is often produced at the furnace and flue seams of many boilers by getting up steam too quickly. The leakage in this case is chiefly due to the unequal expansion of the material, one part of the boiler being hot whilst the rest remains cool. Leakage from this cause is most common in boilers having a bad circulation. Leakage at the ring seams, especially of externally fired boilers, is very often caused by delivering the cold feed water right on the hot plates; sometimes the feed pipe delivers right onto a seam. One of the most common causes of leakage all along the under side of boilers, and also at the tube plates, is the reckless practice of emptying the boiler while still hot, and filling it with cold water, at the same time leaving the damper wide open and removing the flue doors in order to cool the boiler rapidly for cleaning. The sudden contraction of the furnace and flue plates thus produced has been the ruin of hundreds of boilers. The equal contraction of the bottom plates of externally fired boilers is sometimes resisted by the plate edges or suspending brackets butting against the solid masonry; fracture in these cases is the common result.—"Treatise on Steam Boilers," by R. Wilson, C. E. And there may have been some bad workmanship which was unintentionally overlooked.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drop Presses, Punches and Shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 112 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Locomotive Driving-Box Planer Tool. Pedrick & Ayer, Philadelphia, Pa.

Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

Miller's Falls Co., 98 Reade St., New York, are building a Power Frame for their Star Hack Saw.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.

Engines and mach'y, all kinds, new and second-hand. Audubon Machine W'k's, New Haven, Conn.

Roper's Catechism of High-pressure Engineers. $2.00. Theo. Audel & Co., 91 Liberty St., N. Y. Catalogue.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

Most sensitive and durable Damper Regulator made; works within one pound. Send for circular. T. Kieley, 11 W. Thirteenth St., New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N.J.R.R.Ave., Newark, N.J.

25″, 32″, 37″, 42″ — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo., cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Arithmetic of Electricity." A practical treatise on electrical calculations of all kinds, by simple arithmetic only. Just published. Price, $1.00. Send for descriptive circular. Our complete book catalogue mailed free to any address, Norman W. Henley & Co., 150 Nassau St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

The erection of a cotton-mill is talked of at Elberton, Ga.

An extensive steel plant will be established at Ensley City, Ala.

The Opelika (Ala.) Milling Company has increased its capital stock to $40,000.

The Russellville (Ky.) Iron Foundry will be put in operation at an early date.

Work on the Buena Vista (Va.) Steel Works is suspended for the present.

J. H. Gill is to establish an iron foundry and machine shop at Ivanhoe, Va.

Extensive repairs are being made on the cutlery shop at New Hartford, N. Y.

The erection of a factory and cottonseed-oil-mill is talked of at Notasulga, Ala.

It is announced that railroad repair shops are to be established at Blackville, S. C.

Ulrich Eberhardt is building a one-story brick foundry, 83x50 feet, at Newark, N. J.

The Belfast Foundry and Machine Works Company is being organized at Belfast, Me.

The Iron Car Works at Duluth, Minn., started up on the 10th inst., with a force of 30 men.

The Hudson River Aniline Works, at Greenbush, N. Y., are erecting an addition 80x140 feet.

The Glens Falls Paper Company are to erect a pulp-mill 30x600 feet at Fort Edward, N. Y.

An addition will be built this fall to the works of the Athol Machine Company, at Athol, Mass.

Creighton, Sherfesee & Co., Rock Hill, S. C., have added an iron foundry to their machine shops.

J. & D. Noble will erect an iron foundry in connection with their boiler works, at Anniston, Ala.

The Slater Woolen-mill Company has commenced the erection of a three-story mill at Webster, Mass.

An iron or combination bridge of one 155-foot span is to be constructed near McMinnville, Tenn.

A Jackson (Tenn.) company is investigating with a view of removing its machine shops to Sherman, Tex.

The Bar Mills Lumber Company, of Portland, Me., are soon to erect a new mill building 120x22 feet.

The machine shops of G. H. Osbourn, at Clarksburg, W. Va., recently burned, will be rebuilt at once.

The Landon Iron Company, of Salisbury, Conn., has voted to increase its capital stock from $50,000 to $75,000.

The H. Frank Steel Range Company, of Cleveland, Ohio, has been chartered, with a capital stock of $25,000.

The Whitman & Barnes Company are contemplating extensive improvements in their works at Canton, O.

W. H. Bigsley, of New Braunfels, is talking of removing his woolen plant from that point to San Angelo, Tex.

The Ætna Machine Company, of Hartford, Conn., has filed a certificate of increase of capital from $3,500 to $10,000.

Work has commenced on the machine shops of the Norfolk & Western Railroad Company at Lambert's Point, Va.

A company will be organized at Portland, Conn., to light the place by electricity, using the Thomson-Houston system.

The Linwood Iron Works, Linwood, Pa., have perfected plans for new foundry and machine shops of large capacity.

It is currently reported that George Pullman, of parlor car fame, will establish a steel car manufactory at Pueblo, Col.

It is reported that some of the capitalists at Newcastle, Pa., are anxious to buy the old sheet-mill and start it up again.

The Bellaire Steel Works, at Bellaire, O., which closed down on July 3d, will be ready to resume operations this week.

The Central Railroad & Banking Company (office, Savannah) will, it is stated, put new machinery in its Macon (Ga.) machine shops.

A company to manufacture wagon wheels on an extensive scale has been formed at Doylestown, Pa., with a capital of $250,000.

A. F. Childs, W. H. H. Knight, F. F. Dean and others have incorporated the Knight Safety Elevator Company, at Washington, D. C.

The O. S. Wilt Machine Shops, Tennille, Ga., will be put in operation under the management of B. B. Farris, of Rocky Ford, so it is stated.

There are possibilities of an electric lighting plant at New Market, N. H., for which the New Market Electric Company has been organized.

The car shops and roundhouse of the Missouri Pacific Railroad, recently destroyed by fire, at Cypress, Mo., are to be rebuilt on a larger scale.

N. E. Whitaker, Thomas O. Brien, R. Stalnaker and others will organize a stock company for the erection of an electric light plant at Wheeling, W. Va.

The muck-bar and plate-mills of the Roanoke (Va.) Iron Company are about completed. The former will be 332x76 feet in size, and the latter 304x84 feet.

M. P. Robinson has, it is reported, established a $10,000 factory, at Lexington, Ky., for the manufacture of his patent attachment for sewing machines.

The Contoocook Mill at Penacook, N. H., which has been idle for some time, is to be converted into a yarn and twine-mill with an invested capital of $40,000.

The Colorado Coal and Iron Company, Pueblo, are completing a third blast furnace, to be used in connection with their steel works. It will be a 100-ton stack.

The Valk & Murdoch Iron Works, Charleston, S. C., has recently enlarged its boiler shop, and is now putting in a complete hydraulic plant and other machinery.

The Steel Barbed Fence Ribbon Company, capitalized at $250,000, have been organized and incorporated, and will establish a barbed wire factory at Valverde, Col.

The new rolling-mills at Irondale, near Minneapolis, Minn., are now nearly completed, and will be about ready to start by August 1, employing something over 200 men.

Messrs. M. J. Frost, J. N. Hanson and A. Dyrenforth, of Chicago, have incorporated the Taylor Automatic Lubricator Company. The capital stock is placed at $3,000,000.

It is stated that a Mr. Barker, of Pittsburgh, Pa., and others are endeavoring to organize a $200,000 stock company for the purpose of erecting a steel plant at Jasper, Tenn.

The Baker Iron Company, Jasper, Tenn., has registered its charter. This is probably the $30,000 stock company previously mentioned as incorporated to establish iron works.

The Thames Iron Company, of Pennsylvania, has leased the Belvidere Iron Mines, at Belvidere, N. J., and will put in machinery to work them, employing a large force of men.

A new pipe foundry is being erected at Anniston, Ala., to be known as the Anniston Pipe Works. It is expected to have the place started in two weeks, with employment for 200 men.

The Phillips Engine Company have been incorporated at Camden, N. J., with a paid up capital of $100,000, for the purpose of manufacturing and selling engines and other machinery.

The United States Rolling Stock Company, at Anniston, Ala., is being reorganized, with a capital stock of $8,250,000, and probably soon, as is expected, will put its car works in operation.

The Chicago Engine Packing Company has been incorporated, with a capital stock of $50,000, by W. A. Lewis, E. D. Warren and E. D. Pence. The company will manufacture engine packings.

The Brighton Park Mutual Home and Investment Company has been incorporated, at Branchville, Md., to erect electric light plants, gas works, deal in real estate, etc. The capital stock is $250,000.

C. E. Buek and J. E. Bacon, of Chattanooga, Tenn., and A. B. Peterson, of Chicago, Ill., have recently organized a Frictionless Metal Company, and established friction metal works at Chattanooga, Tenn.

The Bates Iron and Steel Company, whose foundry at South Chicago was burned last fall, have decided to locate their foundry at Waukegan, Ill., on land owned by the Washburn & Moen Manufacturing Company.

The new department of the Oil City Tube Works Company will be located at Sharon, Pa., and the whole plant may be removed there eventually. The company have declined the offer of a subsidy to remain at Oil City.

The St. Louis Woolen-mills Company, a new concern recently organized in St. Louis, Mo., has filed articles of incorporation, with a capital stock of $30,000. The stockholders are J. B. Ulrich, James J. Jarvis and F. R. Peters.

E. J. Bird, Jr., of Ironton, Ohio, will erect a muck-bar-mill and nail works at Low Moor, Va. The works will have a capacity of 30 tons of muck-bar per day, and 3,000 kegs of cut and wire nails per week, and will cost $125,000.

The Howe Ventilating Stove Co., of Cortland, N. Y., will erect stove works in Tallapoosa, Ga. The plant will consist of two main buildings 60x250 feet in size, molding-room, polishing-room, etc; nickel-plating plant will be operated in connection.

J. T. Ambrose, H. T. Cooper and others have recently incorporated the Cedar Mountain Iron and Steel Company, at Knoxville, Tenn., for the purpose of erecting an iron and steel plant. J. T. Ambrose is manager; capital stock, $200,000.

The Middleton Car Spring Company, of Philadelphia, has decided to remove its works to Harvey, Ill., a short distance from Chicago. This action was taken in order to get nearer the market, and also the supply of some of the materials used.

Duluth, Minn., reports say that the Minnesota Iron Car Company is about to begin the manufacture of steel plate, piping, refrigerator cars and other iron and steel products. The company has been reorganized, with new capital and new management.

The Elevating Grip and Machine Company has been incorporated at St. Louis, to manufacture elevating machinery and other specialties. The capital stock is $5,000, and the incorporators are Henry Post, Aug. Puff, Jacob Grimm, Thos. Flynn and Theodore Ulschmid.

A new industry is soon to be located in West Granby, Conn. Messrs. Huggins Brothers have bought machinery and will soon begin the manufacture of clocks there. For the present the plant will be located in the building formerly known as Huggins Hall.

The Light, Heat and Power Company has been organized, at Louisville, Ky., with J. S. Briggs, president; Otto Hoffman, vice-president, and August Barth, secretary, for the purpose of operating an electric light plant.

The Ross-Mehan Brake Shoe Foundry Company is reported as having purchased the machinery of the Globe Iron Works, at Sheffield, Ala., and as to remove same to its iron foundry and machine shops at Chattanooga, Tenn.

There is water-works agitation in Scottsborough, Ala.; Barnesville, Ga; Guthrie, I. T.; Phelps, N. Y.; Grafton, N. Dak.; Winnebago, Minn.; Davenport, Iowa; Quincy, Mass.; Woodstown, N. J.; Brooklyn, N. Y.; Frederick, Md.; Chadron, Neb.; Selma, Ala.

H. W. Matthews, Carl Wille, Ernest Stoffregen and others have incorporated the Oriole Tablet Machine Company, at Baltimore, Md., to manufacture machines for the manufacture of compressed tablets for medicines, etc. The capital stock is $15,000.

Ground has been broken for the new horse-shoe factory, to be erected at Milwaukee, Wis. The commencement of work on the building has been delayed somewhat, and it is intended to rush its construction. The machinery for the factory has been ordered.

A tract of sixteen acres of land, at the junction of the Belt and Illinois Central railways in Illinois, has been purchased by the National Malleable Iron Casting Company, for $40,000. On this property, as a site, it is proposed to erect a plant which will give employment to 600 men.

The Peck, Stow & Wilcox Company, located at Southington, Conn., are making improvements to their foundry in the shape of a new cupola and furnace. It will be of greater capacity than the old one. An elevator, run by water pressure, will also be added for hoisting iron to be melted.

The Benjamin Atha & Illingworth Company, steel makers, of Newark, N. J., are erecting a new foundry, which will be equipped with Ridgway cranes. They will be of 28 feet mast, 23 feet radius, 10 feet lift and six tons capacity. They expect to have the new foundry in operation in about six weeks.

The Johnstown Company, Johnstown, Pa., has placed stakes for a large machine shop and roll-mill, 365x50 feet, and work will begin at once. Work on the new machine shop located near the switch works is also being pushed forward, and another large force of skilled men will soon be in demand.

The newly organized Monongahela Iron and Steel Company, of Pittsburgh, Pa., which concern is building a plant at Hays Station, near that city, for the manufacture of muck-bar, will apply for a charter in August. The incorporators are R. A. Carter, Robert G. McKillon, Robert McDonald, Percie Preston and others.

It is stated that George Wallace, of Boston, Mass., representing a syndicate of capitalists of that city, has purchased the Columbia Canal for $260,000, the syndicate to erect cotton factories in the city limits, to be operated by water-power from the canal. The removal of several New England cotton factories to Columbia, S. C., may result from the sale.

John Maslin & Son write us: "We have opened our headquarters at Messrs. Lathrop & Co.'s, 66 Cortlandt street, New York, where a sample pump can be seen, and all necessary information obtained. Business is fair, and we are supplying large quantities of our improved parts for Pulsometer pumps, increased facilities enabling us to reduce prices greatly."

Inducements have been offered Mr. G. E. Sharp to move the large foundry of which he is the head, from Steubenville to Youngstown, Ohio. It is said the proposition made to the foundry people amounts to some $25,000 cash, and is quite an incentive to them to make the removal. A proposition is under consideration by the live Steubenville citizens, who desire that the foundry remain there.

Mr. O. Wilh Dahlgren, Superintendent of Arboga Mekaniska Verkstad, Arboga, Sweden, manufacturers of cars, wheels and axles, cranes, mill machinery, pulleys and shafting, engines, boilers and various other machinery, in a letter to us gives us the size of shops as follows: Machine shop, 60x250 feet; foundry, 72x200 feet; blacksmith shop, 50x140 feet, and another shop, 40x100 feet. The works were founded in 1858.

The Raub Locomotive Works has been incorporated, with office at New York City; capital stock, $5,000,000. The company proposes to construct and operate locomotive and machine works. This is understood to be a West Virginia enterprise The incorporators are D. C. Raub and James H. Barrett, of Paterson, N. J.; W. C. Raub, St. Louis, Mo.; Albert Sibley, Brooklyn, N. Y.; Jesse Larrabee, New York City.

We referred in these notes last week to the fact that John J. Grant and Robert H. Grant were to build shops and start in business at Fitchburg, Mass., under the title of the Grant Machine Tool Works. The size of shop as then given was not quite correct, as we learn by a letter from the firm. The main shop will be 30x100 feet, with ell for engine-room and blacksmith shop 20x30 feet. The company expects to get into the shop about August 15.

The Fossil Meal Company, 2 Cedar St., New York, has just finished the covering of the boilers and steam pipes on the Pennsylvania Railroad Company's double-deck ferry-boat New Brunswick, with the William Berkefeld's fossil meal composition, and will shortly start to cover the boilers of the new Pennsylvania Railroad Company's ferry-boat Cincinnati. The new ocean fast steamers Augusta Victoria, Columbia, Havel, Spree, Furst Bismarck, Teutonic, Majestic and Kaiser Wilhelm II. have their boilers covered with this composition.

The Hardsoog Manufacturing Company, Ottumwa, Iowa, has been recently incorporated, with a capital stock of $30,000. This new concern succeeds to the business of Martin Hardsoog, who was burned out in March last. The company will make a specialty of coal-drilling machines, coal miners' tools and steel body ore, and pit cars, and also controls patents on many patterns of coal drilling machines, and on machines for making coal augurs. The company will soon occupy its new factory building, which is considerably larger than the one burned, and which will be equipped with new machinery throughout.

An Engineer's Observations in Europe.

Mr. Chas. A. Bauer, M. E., called at our office a few days ago on his way home from a European trip of about three months duration, a portion of which time was spent at Carlsbad, whither he had been temporarily banished by his physician. He returns very much improved in health, and with a considerable stock of special information picked up among the various European industrial establishments. He expresses himself as being very favorably impressed with many of the things seen there, especially in Germany, the country he saw most of. Their workmanship is, he thinks, for the most part thoroughly conscientious and good.

He confirms the opinion of other competent observers as to the relative efficiency of foreign and American mechanics, and amongst other instances mentions an establishment in Germany doing about the same class of work as that turned out in his own establishment. The number of employes in the German works was 2,100, and he declares that with an investment of about $10,000 for tools he would do the same work easily with 600 American workmen. In a foundry, a German molder was making the main driving wheels of lawn mowers. He received an equivalent of 90 cents for a day's wages, and put up nine molds a day, two wheels being gated together. An American molder on the same work would think nothing of putting up fifty to seventy-five molds a day. In one place two men were seen making half-inch rivets. One of them was doing the heating while the other was making the heads by a drop-forging process. Timing them, Mr. Bauer found they were making twelve rivets per minute. In his own establishment one man with a machine for the work makes such 112 rivets per minute. Comment is not needed on these figures; they tell their own story. The returns on capital invested in manufacturing enterprises he thought were generally much smaller than in this country, an industry there returning 3 per cent. upon the investment being considered to be doing quite well.

Machinery at the Columbian Exposition.

From a decision by the directors of the Columbian Exposition, and the extensively copied comments of a trade journal thereon the impression has been formed in some quarters that no manufacturing operations of any kind are to be carried on at the exhibition, except in the department where raw materials are exhibited. If this were true it would prevent many machines from being shown at all to any advantage, for the reason that, unless they can be shown in operation, there is little if any use in showing them at all. We find upon inquiry, however, that any exhibitor of machinery in Machinery Hall, where, of course, the bulk of the machinery will be shown, may carry on such manufacturing operations as are necessary to properly exhibit his machines, and will, upon application, be given proper space, and furnished with any reasonable amount of power, free of charge.

The fact that Machinery Hall is to be the largest building on the grounds (500x850 feet), shows the importance that is attached to the exhibit in this class, and it now seems probable that the greatest and most complete exhibition of machinery will occur there that has ever been seen. It would be well, we think, if builders and manufacturers of machinery would early awake to a realization of this fact, and commence their preparations for representation early enough to enable them to get the full benefits. Machinery is more generally used in this country than in any other on the face of the globe; we may be said to be a nation of machinists and machinery users, and this fact should be made apparent by our exhibit at Chicago. Twenty-four foreign nations have now officially accepted an invitation to be represented, including every nation of importance, except Italy, and there is every prospect that vast numbers of foreigners will be attracted as visitors. Foreigners are

becoming more and more the customers of American machinery builders, as the peculiar merits of our machinery become better understood abroad. It is probable, too, that the machinery export business from this country will be increased as a result of the extension of the reciprocity idea, and other influences, and the time is coming when it will pay an American manufacturer of machinery to be known abroad. The Columbian Exhibition will afford an excellent opportunity of becoming thus known, and we hope it will be appreciated by our machinery builders generally.

The Education of an Engineer.

In its issue of July 17, *The Engineer* (London) contained the following editorial article, which, to say the least of it, affords some food for thought:

In our impression for June 19th we called attention to a paper by Prof. Hele Shaw on the education of an engineer, read before the Liverpool Engineering Society. We have since received a copy of the discussion, which occupied the whole evening of the 18th of March. The discussion was not adequate to the paper which elicited it. Discussions seldom or never equal the papers which they follow in interest or value. This particular discussion was remarkable principally for the diversity of opinion expressed as to the best method of teaching a young man his profession. Thus, for example, Mr. Henry West held that the half-time system—six months spent in the shops and six months in college, turn about—was the worst possible method of teaching, while Mr. Higginson stated that, according to his experience, it was the best possible system. Most of the speakers, however, manifested a due appreciation of the value of practical training, as compared with "book learning," and, on the whole, approved of Prof. Hele Shaw's views. The paramount defect of the whole discussion was, however, its exceeding vagueness. That is the defect of all discussions on the subject; and we write now in the hope that those who think, and speak, and write on the education of an engineer may be brought to see how this want of crystallization of thought does harm, and raises false issues, and that, thus seeing, they may mend their ways, and contribute something in the way of reasons, or advice, or information, which shall be of value.

Let us then suppose that a young man of, say, 17 is to be made a mechanical engineer, and that it is known that his principal work will consist in constructing steam engines and boilers. The engines will be of various kinds; the boilers of no single type. It is further to be supposed that he will work steadily up until he becomes a manager, and even ultimately a partner. What is the best training for a young man under these circumstances? We think we may say, without fear of contradiction, that what will best suit him will not necessarily best suit a young man whose life will probably be spent in designing and making iron bridges and roofs. Nor is it likely that his training should be identical with that of a man intending to undertake the construction of cotton machinery or of agricultural implements. In order to avoid being vague, we shall confine ourselves wholly to the consideration of the case presented by the young man who has to make and sell steam engines and boilers. We shall be told by some people at once that it will be of the greatest possible service to this young man to learn all about thermodynamics and dynamics generally. He must also gain a good knowledge of mathematics; and if he combines with this a little sound chemistry, so much the better. There are many other things which are roughly classed under the head of "science" which he ought to learn. Now it is very easy to say all these things will be of use. But no one ever stops to answer the question, of what use? It may startle, and even shock some good people, if we say that in nine cases out of ten a knowledge of thermodyamics is of no use whatever to the maker of steam engines; and that he has absolutely no use for any mathematical knowledge which goes outside the rules of arithmetic; and the reason is that steam engines and boilers are not the result of mathematical investigations, but simply of precedent. What, for example, is the use of teaching a young man how to calculate the proper diameter for a crank-shaft, when proper diameters never are calculated, and if they were, the result would certainly be wrong? This may sound heretical, but our readers who are really steam engine makers know that it is true. When a young man goes into the drawing-office from the shops, he will find that all the proportions of the parts of the engines and boilers made by the firm are ready cut and dried for him. The prominent idea of some makers is to put in the smallest crank-shaft that can be got to stand. On the other hand, in certain districts a steam engine cannot find a purchaser unless it is of the most massive proportions; no book or college can help our young man here. But, whatever the nature of the demand, no one ever dreams of calculating the diameter of a crank-shaft. A certain diameter cylinder and a certain crank-shaft go together; they have given good results hitherto, why depart from them? If any of our readers will turn to Bourne on "The Steam Engine" they will find elaborate tables of dimensions of parts. These are the results of extended practice. The figures represent the best work of the time when they were compiled. Much the same kind of thing exists at this day in every drawing-office. Sizes are either recorded in tables and hung on the walls, or they are to be found on drawings of engines which have already given satisfaction. In designing boilers, again, there are certain cut-and-dry rules from which no one with a reputation thinks of departing. If our readers will take the trouble to compare dimensions of crank-shafts, for instance, in large marine engines, they will find a wonderful sameness. The exceptions are to be met with in the navy, where crank-shafts and other parts are made lighter, with very doubtful advantage, than in the mercantile marine. As to a knowledge of thermodynamics helping any one to improve the steam engine, all available evidence goes to demonstrate the direct contrary, and that all the best work has been done by men who knew little and cared less for thermodynamics. For our supposititious young man mathematical training is of no direct value whatever. It may, however, prove of great indirect value by teaching him how to reason and draw conclusions. But logic would probably answer better. The proper training for our young man is that which teaches him to keep his eyes open; to see what is and what is not successful, either in his own practice or that of other people, and to endeavor in all cases to find out why any method of construction which seems novel has been adopted.

There is nothing like an anecdote for enforcing a lesson. A young engineer, trained in college, saw a certain compound horizontal engine, and this engine pained him because the crank-shaft was much too thick; and there was, besides, a third bearing—a short one, it is true, but still a bearing—squeezed in between the cranks. He felt within himself that this was waste of material, and he calculated the strength of the crank-shaft by the most approved formulæ, and he saw that it was ridiculously too strong. The engine was in an exhibition, and, unable to bear the mental strain, he got hold of some one who represented the maker—one who, fortunately, knew what he was talking about—and to him the troubled youth poured out his soul, and asked why the crank-shaft was so strong, and why there was a third bearing. He was told that the shaft would not run cool otherwise, and, wanting to know why, he was further informed that the shaft would "whip" unless it was very stiff; that the third bearing was introduced to gain still more stiffness, and that if the shaft whipped, experience proved that it would run hot. That young man went away much wiser. He had learned that there were things about steam engines not stated in books, and we have no doubt that he kept his eyes open in future, and learned much that he would otherwise have missed.

In one word, then, the best training for a young engineer intending to make steam engines and boilers, is that which consists in studying the best examples that he can find of steam engines and boilers, and bringing to his assistance, in assimilating what he sees, the practical knowledge which he acquires in the shops. Thus, for example, he sees on an engine a certain form of valve gear. If he is wise he will take thought not only for the mode of action of the gear, but for the way in which it was made. We are not now talking of patented inventions, but of familiar details. He has, for example, to wait at a railway station, and possibly half a dozen different engines stop at the platform; no two will have the links made or carried in the same way. The chances are that if he keeps his eyes open he will get a hint which will enable him to cheapen and improve the valve gear he is fitting onto a certain small winding engine now in his own shop, and so on. Nothing is more valuable to the engineer than a power of observation, and this should be backed up by the ability to make freehand sketches with accuracy and dispatch. That is an art which is hardly ever taught as it should be.

It may perhaps be urged that we are advocating simple robbery of ideas, but we do nothing of the kind. The man who is unable to do anything but steal ideas will soon find that servile imitation means bankruptcy. Every engineer, every professional man, every artist depends for the production of good work on the labor not only of his predecessors, but of his contemporaries. The man who, shutting his eyes to all that goes on around him, resolved to elaborate a steam engine out of books and his own brains, would produce nothing worth having. The true education of the engineer who makes steam engines and boilers, lies not in acquiring a knowledge of mathematics or thermodynamics, but in seeing how steam engines and boilers have been made, and how they are made now, and learning why they are made in any particular way. If his powers of observation are backed up by that intuitive sense of mechanical fitness which has been termed mechanical instinct, then he will be on the road to success.

Where there is time available, considerable benefit can, as we have often said, be derived from a college course, but this applies far more to the youth who is absolutely ignorant of all that concerns mechanical engineering, than to the youth who at least knows that a locomotive has not "got a lot of wheels and things" inside the boiler; nor does what we have said apply to other branches of engineering. A civil engineer, for example, has to resort daily to mathematics in doing his work, and a great deal of civil engineering can be learned better at college than anywhere else. The bridge builder, ignorant of mathematics, and lacking knowledge of graphic statics, will be continually at a loss. The non-mathematical shipbuilder is a monstrosity. Herein lies, indeed, one of the great obstacles to success in college training. The course which suits one set of students is useless for another set. It becomes, in a word, impossible to lay down any hard-and-fast rule It may be taken as certain, however, that much useless knowledge is in all cases forced upon the student; and this does not represent the whole mischief, because the acquisition of this brain lumber not only shuts out that which is really good, but tends to produce a habit of thought which is radically bad. If the student once acquires the custom of resorting to books for everything, he will destroy his powers of observation. He will literally give up the substance for the shadow.

Finally, we would suggest to our readers, and to professors particularly, that they should formulate their views on any particular branch of instruction, and show in what way that particular branch will be of service to a young man. We would suggest, for instance, as a thesis, "The way in which a mastery of 'Clausius on Heat' will enable an engineer to improve the steam engine." But other examples may be taken, as, for instance, "The effect which Cotterill's treatise on the steam engine has had on the development and management of engines in the navy." A discussion based on information of this kind, properly carried out, could hardly fail to do good by bringing facts before the world, instead of vague expressions of opinion.

The employes of the De La Vergne Iron Works held their first annual excursion to Cornwalton Grove on Saturday, July 25, which proved to be a great success, both socially and financially. The foremen of the different departments organized themselves into a committee to see that none went home dissatisfied, and showed themselves worthy of the occasion. James McIntyre, of the machine-room, proved himself a strong sprinter by winning the gold medal in the 150-yard dash, the silver medal going to an outsider—Mr. John Murphy—100 yards.

The Samuel L. Moore & Sons Co., of Elizabeth, N. J., gave their five hundred employes a free excursion to that delightful summer resort, Lake Hopatcong, on Monday, August 3. There was a full attendance, of course, as there always is at these annual picnics, and equally, of course, there was a very enjoyable time.

We frequently receive communications from inventors and others asking why they should not transact their business direct with the patent office rather than through an attorney. The only reply to this seems to be by asking another question, viz., why not be your own doctor or lawyer? We do not see that there is any difference in the propositions. A patent attorney, if a good one, has studied his business, just as a carpenter or a mason has studied the construction of houses.

Machinists' Supplies and Iron.

NEW YORK, August 1, 1891.

Iron—American Pig—There is some improvement in the demand and prices are maintained.

We quote: No. 1 Foundry, Standard Northern brands, $17 to $18; No. 2 is selling at $15 to $16, and Gray Forge at $13.90 to $15.25. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $24.50 for Coltness; $22 for Dalmellington; and $20.50 for Eglington.

Copper—The market is weak, and Lake is quoted at 12¼c.; Arizona Ingot is quoted at 12c. to 12⅛c.; Casting Copper, 12⅛c. to 12¼c.

Lead—The market continues quiet and steady, with values ranging at 4.35c. to 4.45c.

Spelter—The demand is not active, and supplies can be obtained at 5.05c.

Tin—Business is rather dull, and the market is steady. Values range from 20.35c. to 20.60c.

Antimony—The market is dull and prices easy.

We quote Hallett's at 11½c. to 11¾c.; Cookson's, 13c. to 13¼c.; and 12c. for L. X.

Lard Oil—Prices are maintained at 52c. to 53c. for City; Western at 51c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Good tool maker. Must furnish good reference. H. Mueller Mfg. Co., Decatur, Ill.

A1 die sinker wants steady employment. Address Lock Box 1211, Pullman, Ill.

A mechanical engineer (mem. A. S. M. E.) with office in New York, desires to represent the manufacturer of some specialty. Box 21, AM. MACHINIST.

Wanted—A foreman pattern maker with general experience. Address, giving references, Birmingham Iron Foundry, Birmingham, Conn.

Wanted—Position as draftsman by an apprenticed mechanic with technical education and exp. in drafting-room; age, 23. W. L. S., AM. MACHINIST.

Wanted—Situation as foreman blacksmith; 10 years' experience as such; best references. Address Box 32, AMERICAN MACHINIST.

Mech. engineer, good designer, prac. machinist & engineer, desires position as foreman or supt. in a mach. shop; speaks 4 languages. Box 31, AM. MACH.

Wanted—To correspond with machine firms in need of foreman or superintendent for their shops. Address P. L., AMERICAN MACHINIST.

A graduated mechanical draftsman, experienced in general machinery and superintending of work, wants position. P., AMERICAN MACHINIST.

Wanted—One good pattern maker; state age, experience, and wages expected. Address to Kenney & Co., Scottsdale, Pa.

A1 mechanical draftsman is open for engagement; is a graduate, experienced; steam engines preferred. Address Box 34, AMERICAN MACHINIST.

An experienced machinist and tool maker, at present holding position as foreman, desires to make a change about Sept. 1st; South preferred. Address Box 33, AMERICAN MACHINIST.

Wanted—For a good, permanent position, a first-class general machinist and tool maker. Address, stating age and experience, F. A. Hunter, No. 129 Fourth street, Detroit, Mich.

Wanted—Position; mechanical draftsman; 7 yrs' experience designing machine tools and special fixtures. Box 29, AMERICAN MACHINIST.

Wanted—At once, a thorough, practical and competent mechanic to take charge of tool-room; must be first-class in all respects, and able to handle men; state experience, giving age, references, and salary wanted. Address Tools, AM. MACHINIST.

Wanted—At Pittsburgh Locomotive Works, Pittsburgh, Pa., a competent foundryman to take charge of iron and brass foundries; must be active, entirely temperate, and thoroughly understand locomotive work; state salary expected, and give references.

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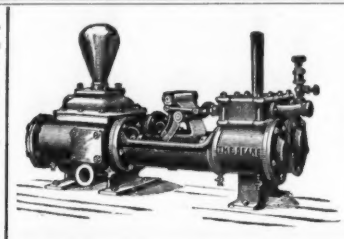

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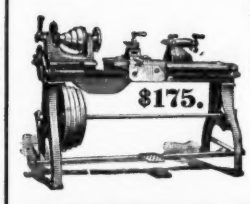

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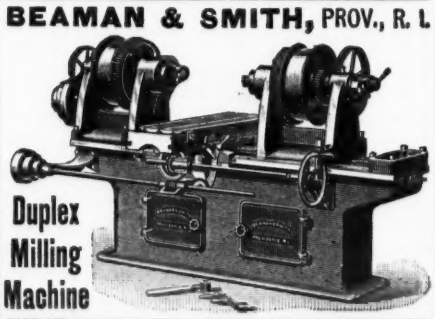

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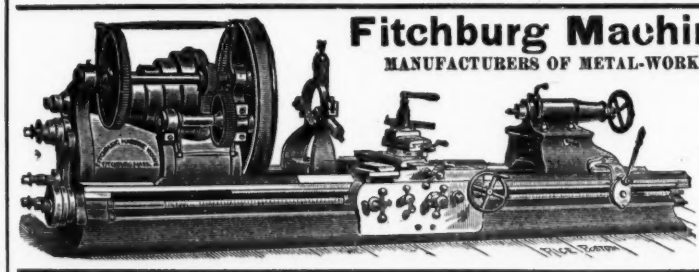

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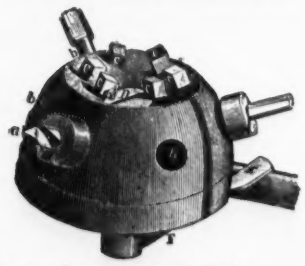

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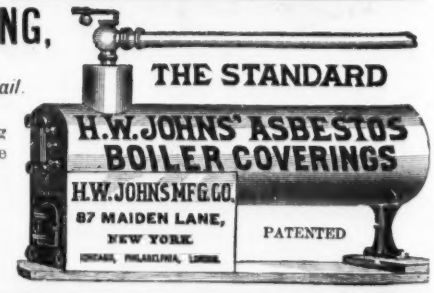

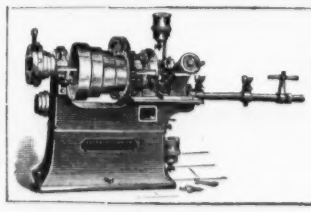

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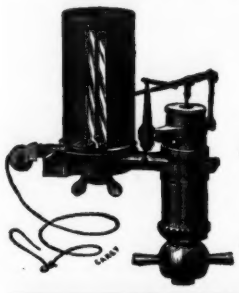

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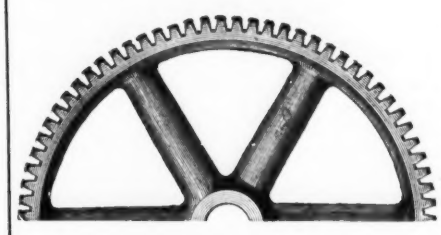

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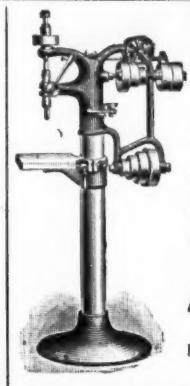

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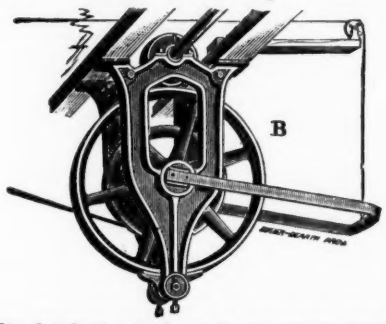

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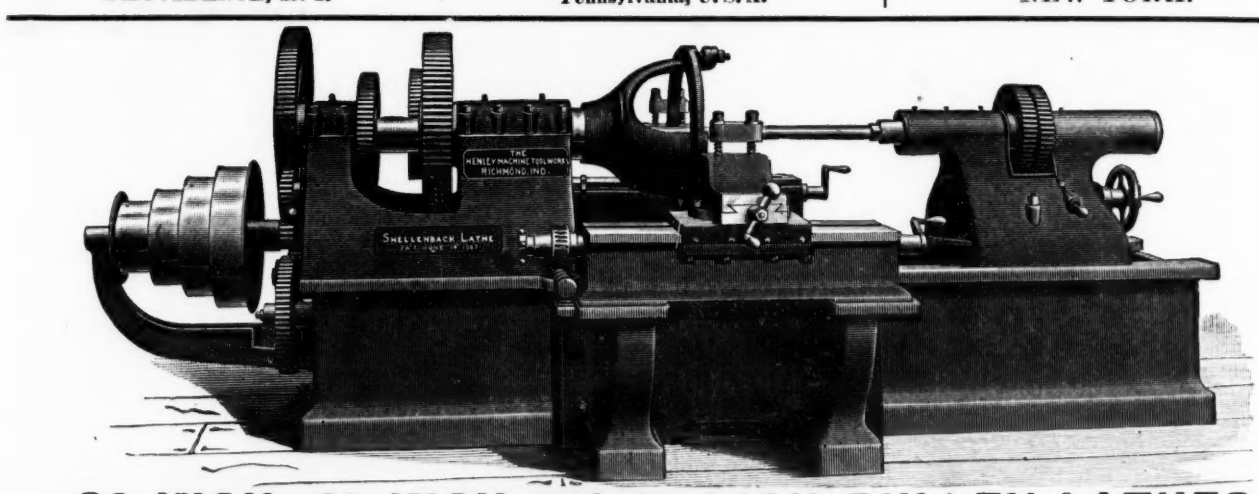

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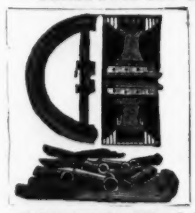

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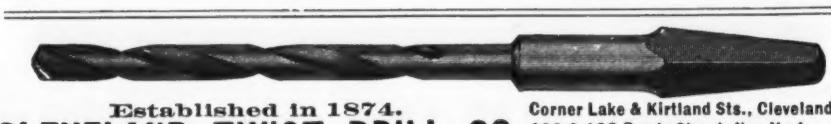

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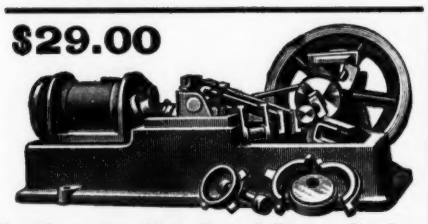

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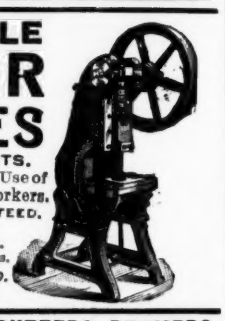

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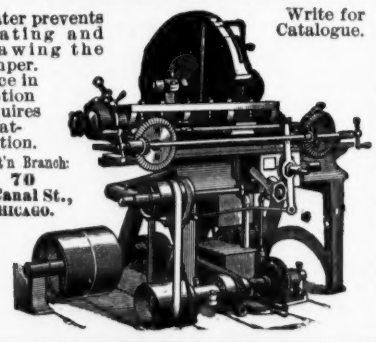

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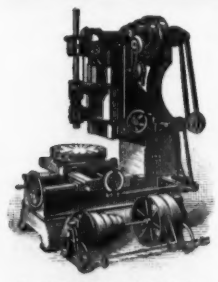

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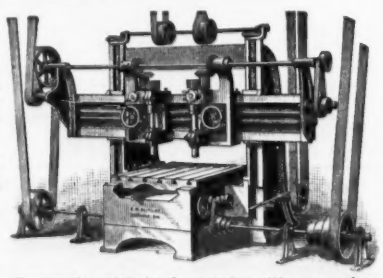

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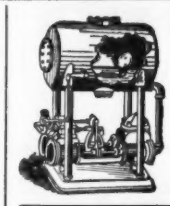

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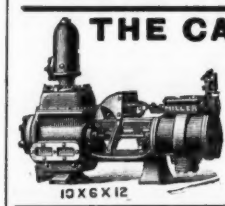

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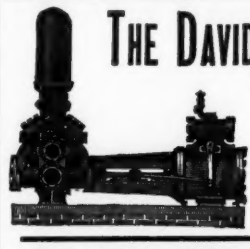

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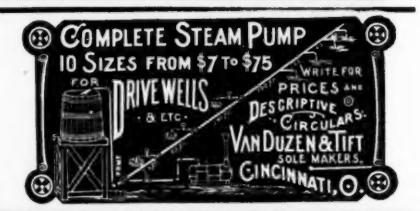
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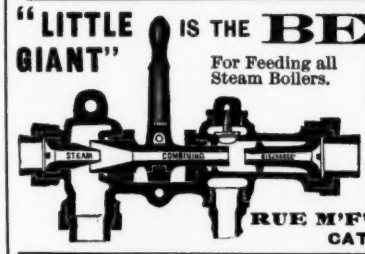

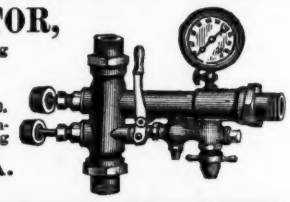

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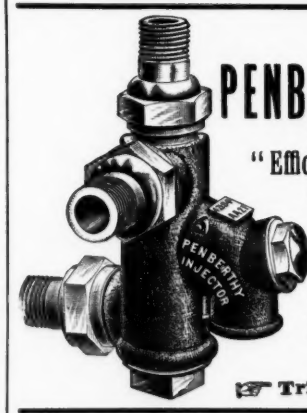

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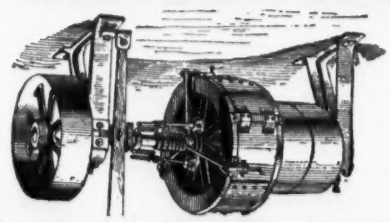

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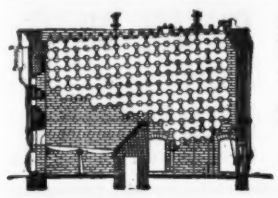

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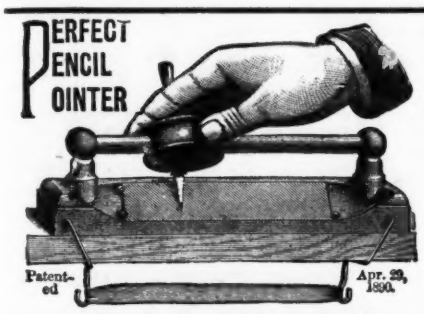

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16 in.	18 in.
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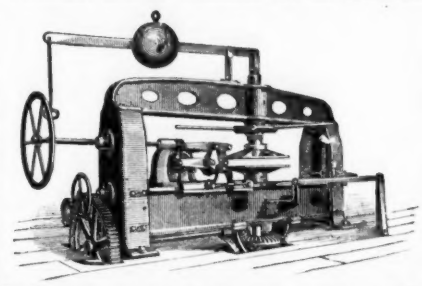

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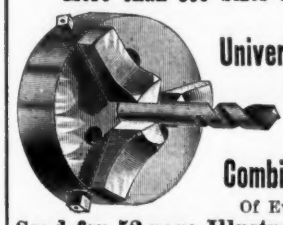

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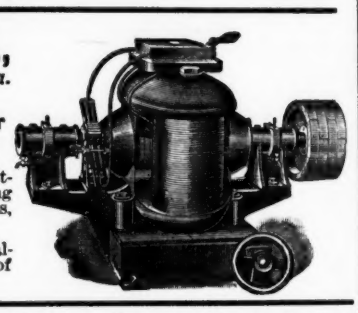

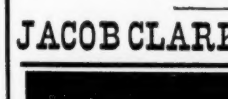

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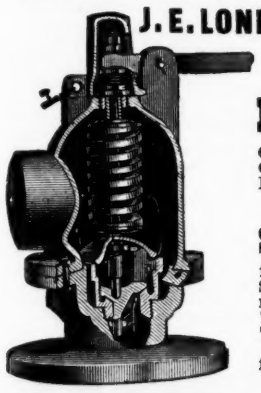

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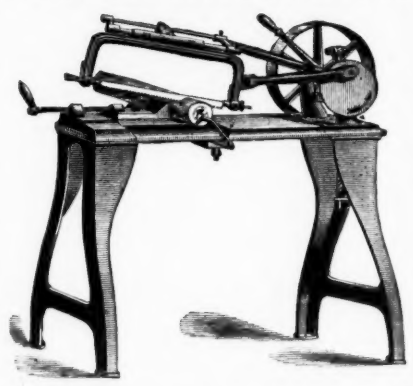

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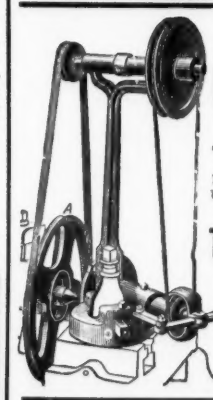

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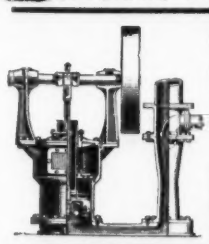

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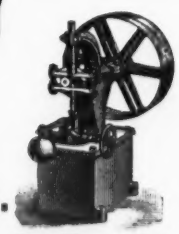

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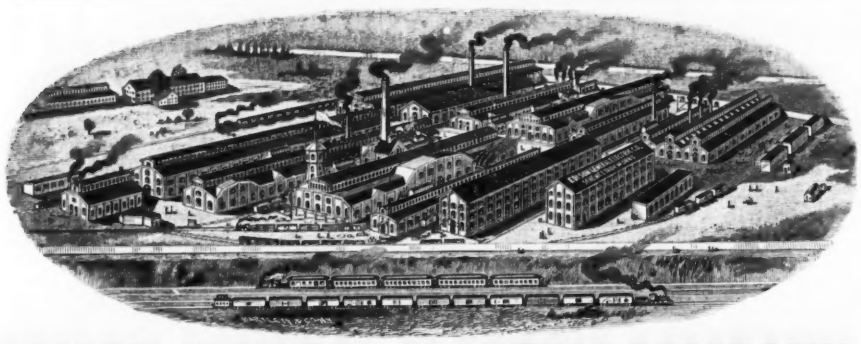

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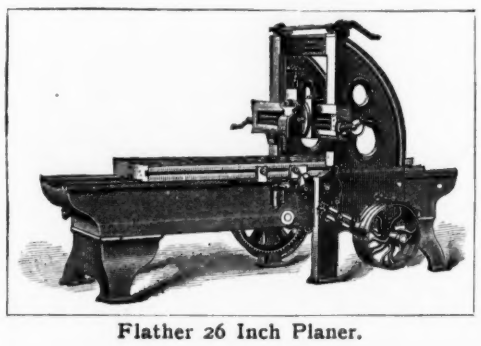

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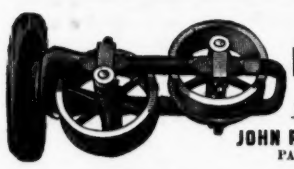

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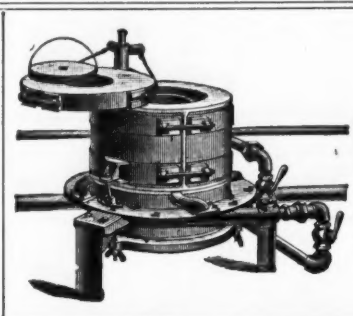

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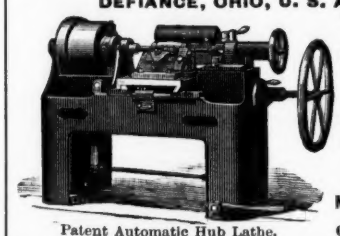

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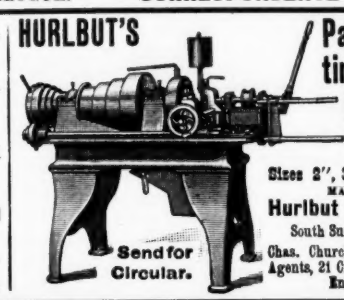

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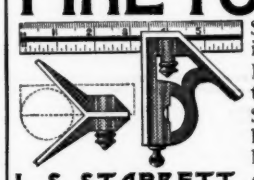

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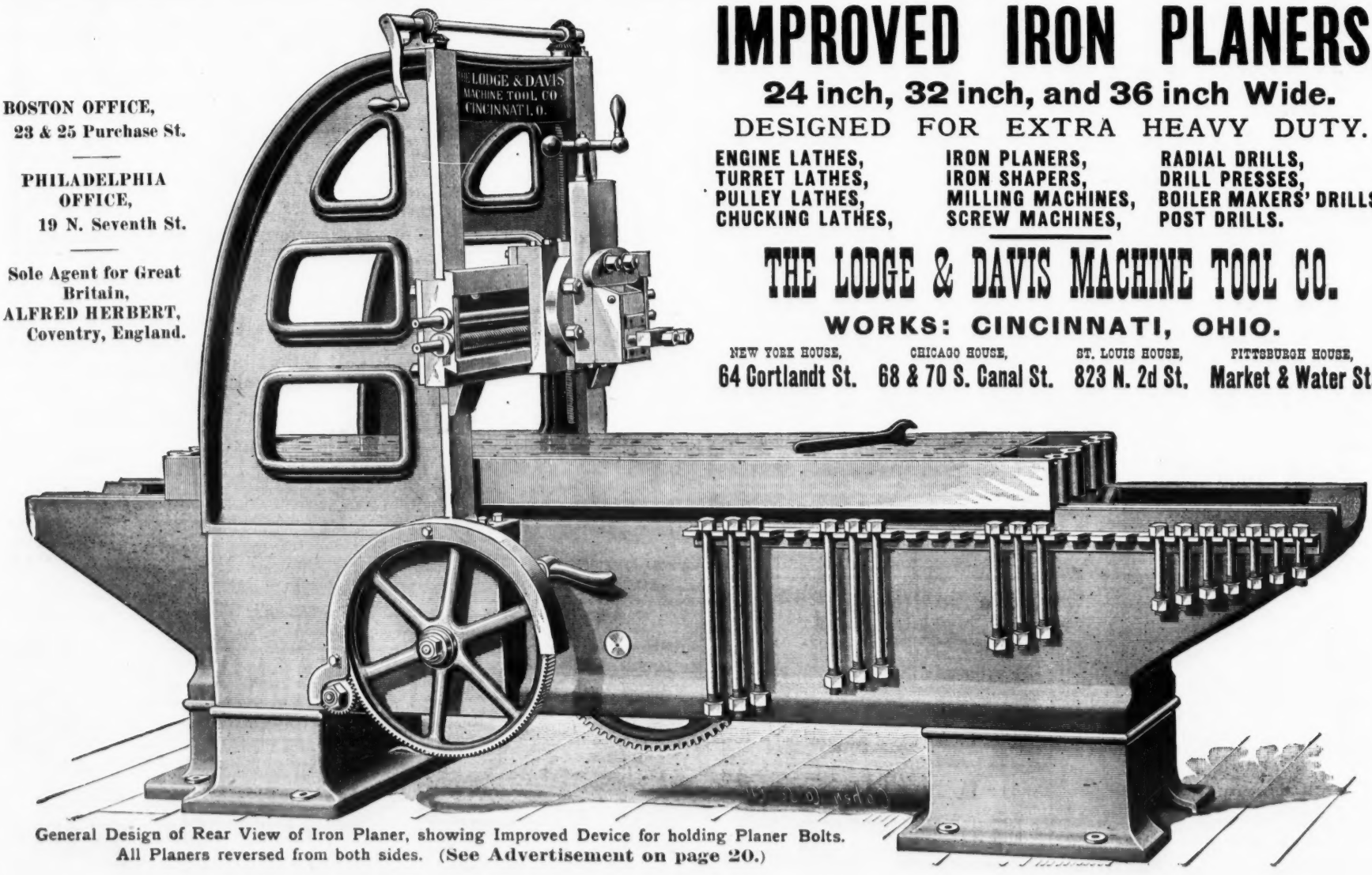

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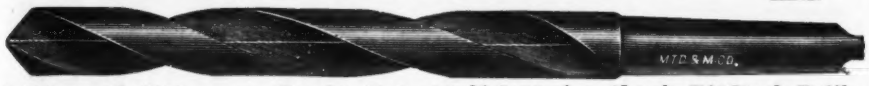

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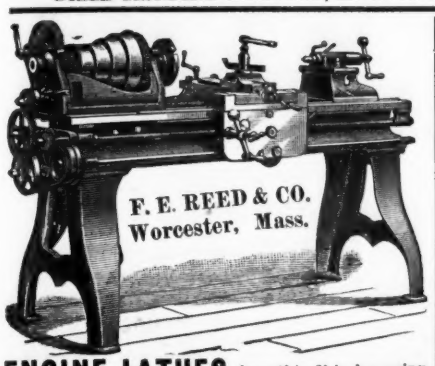

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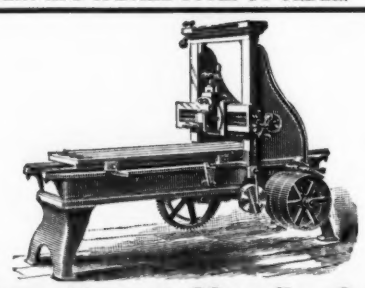

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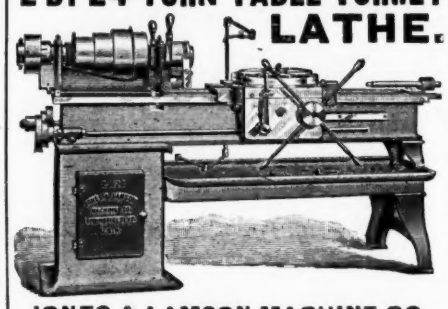

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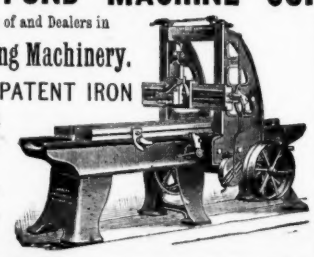

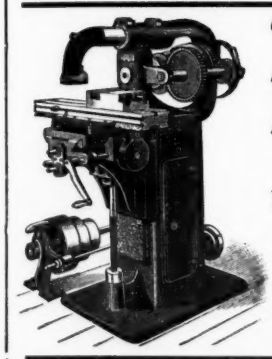

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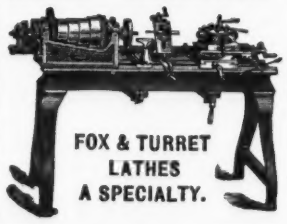

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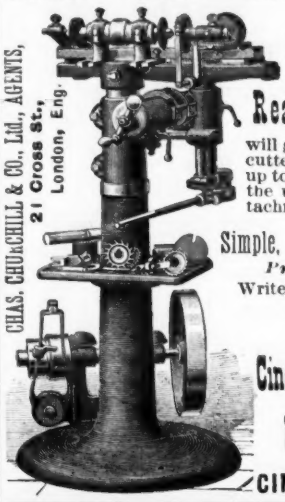

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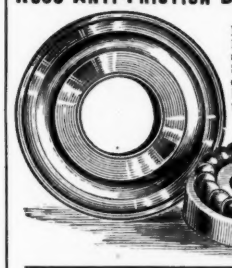

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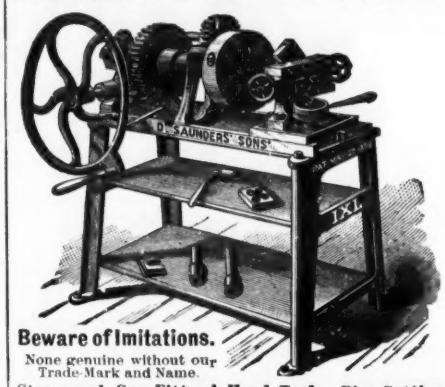

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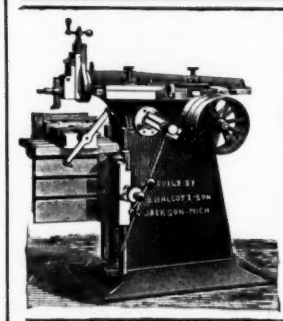

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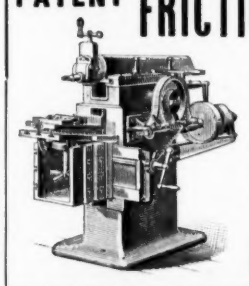

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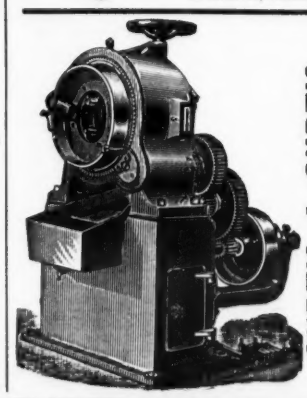

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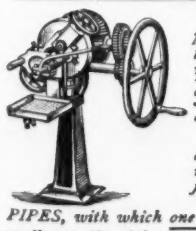

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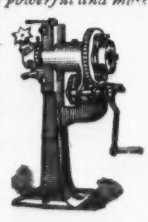

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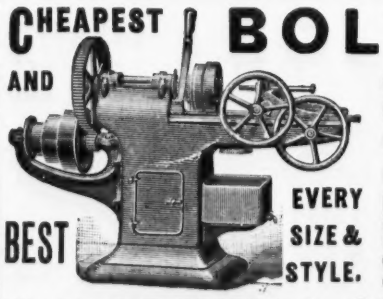

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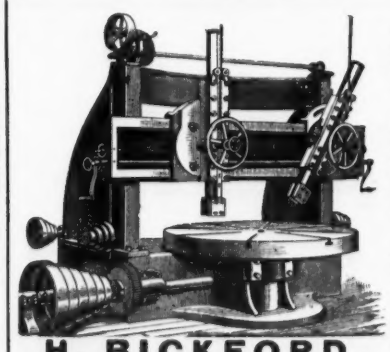

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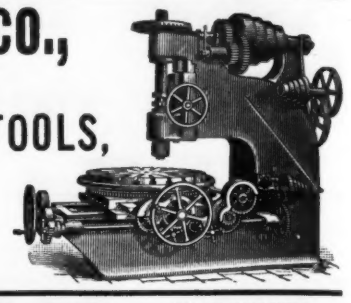

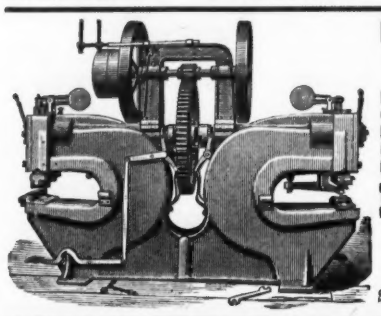

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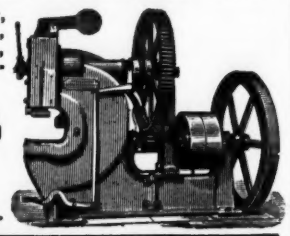

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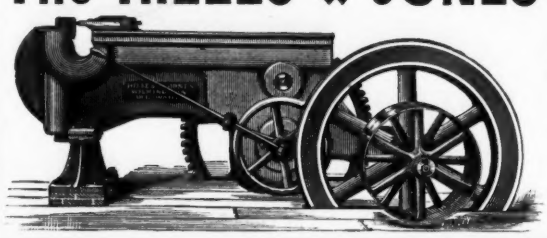

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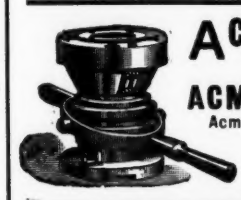

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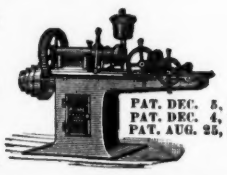

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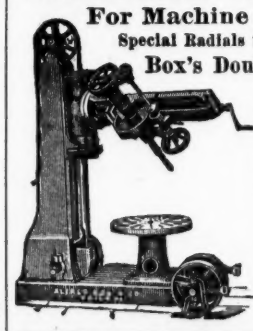

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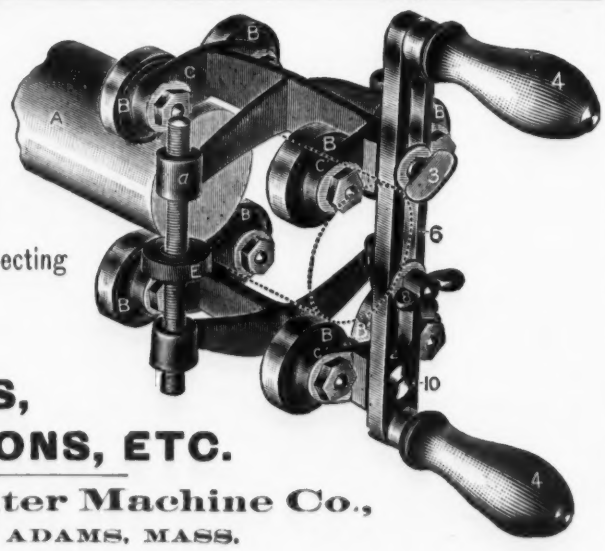

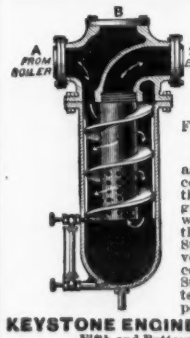

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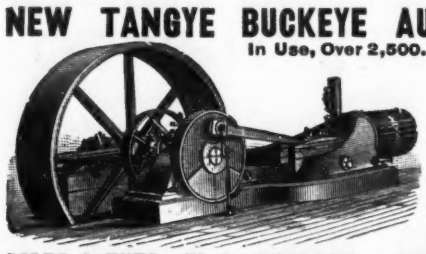

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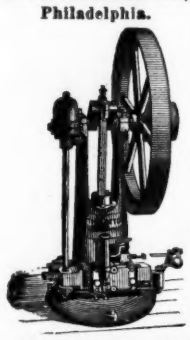

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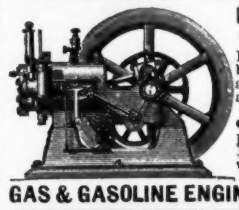

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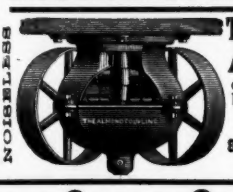

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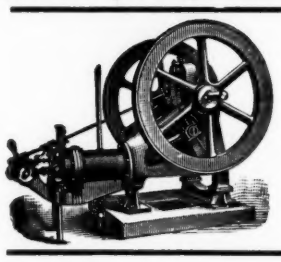

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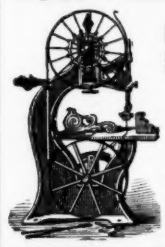

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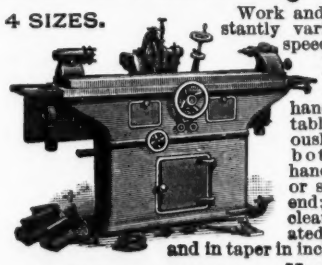

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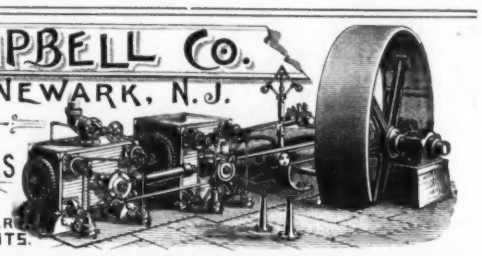

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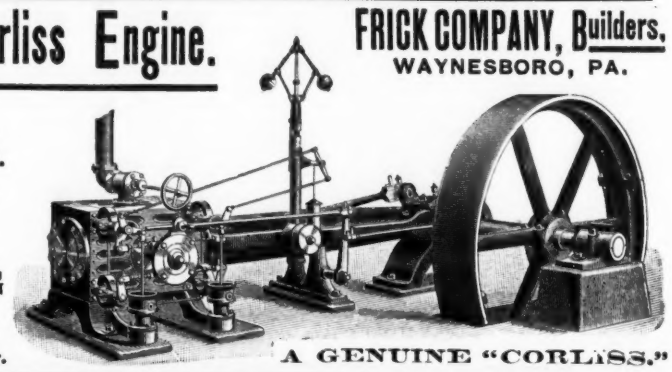

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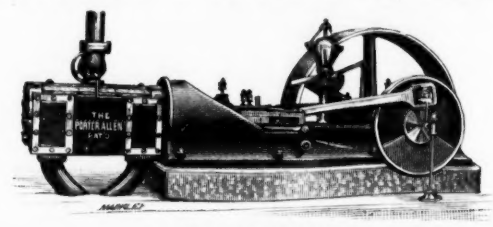

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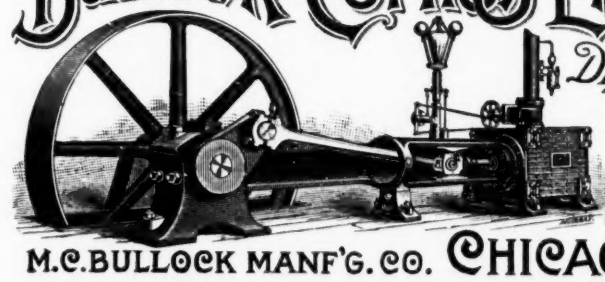

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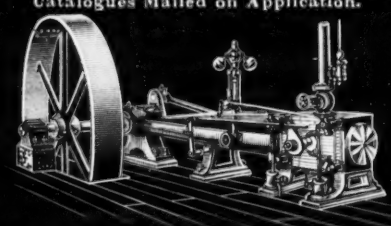

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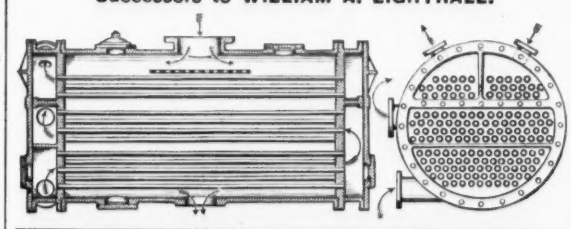

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No. 1 Universal Grinding Machine.

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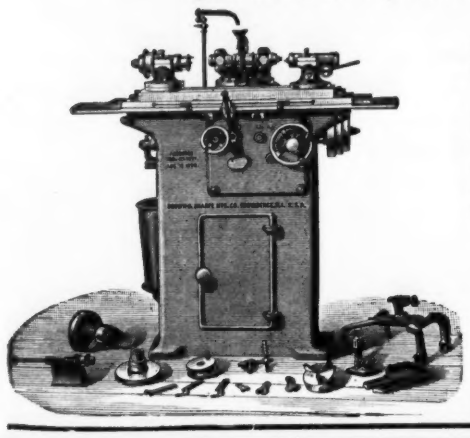

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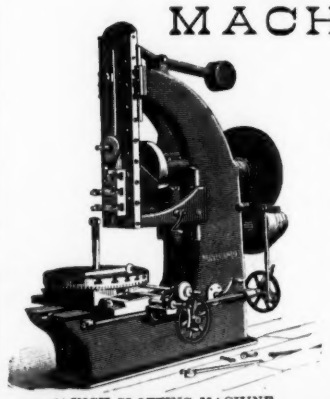

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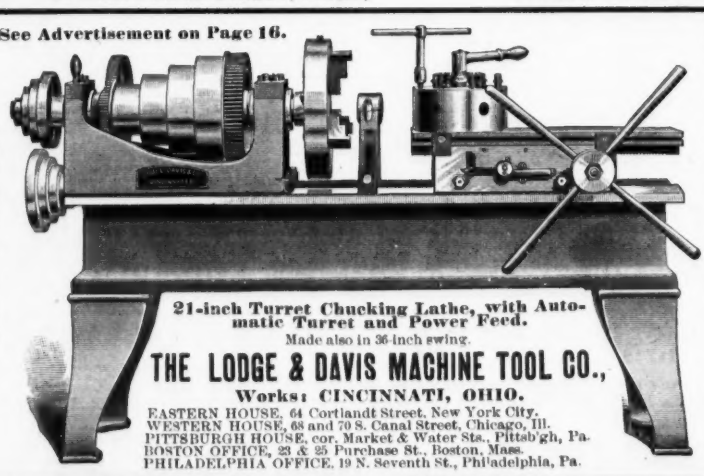

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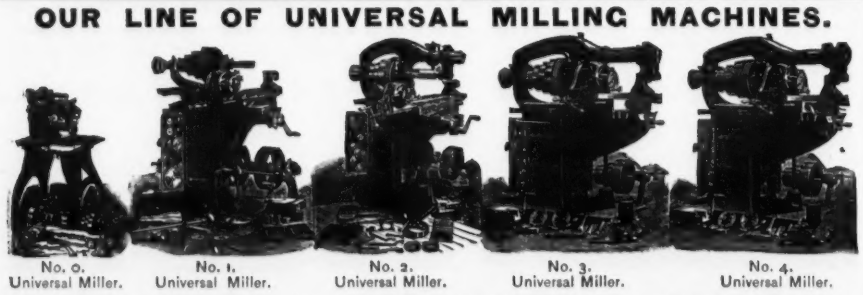

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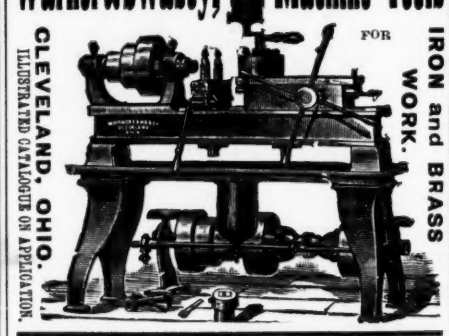

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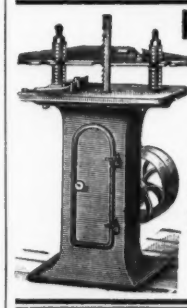

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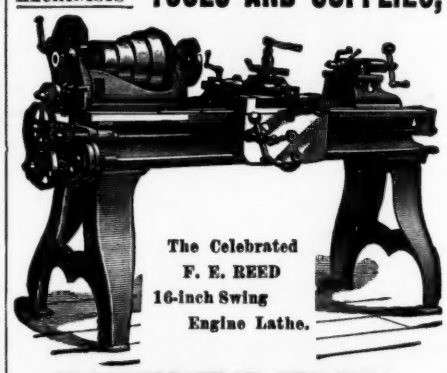

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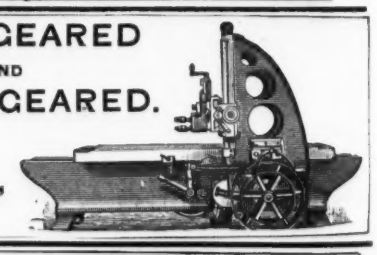

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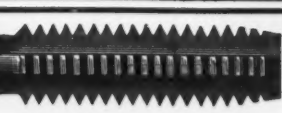

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